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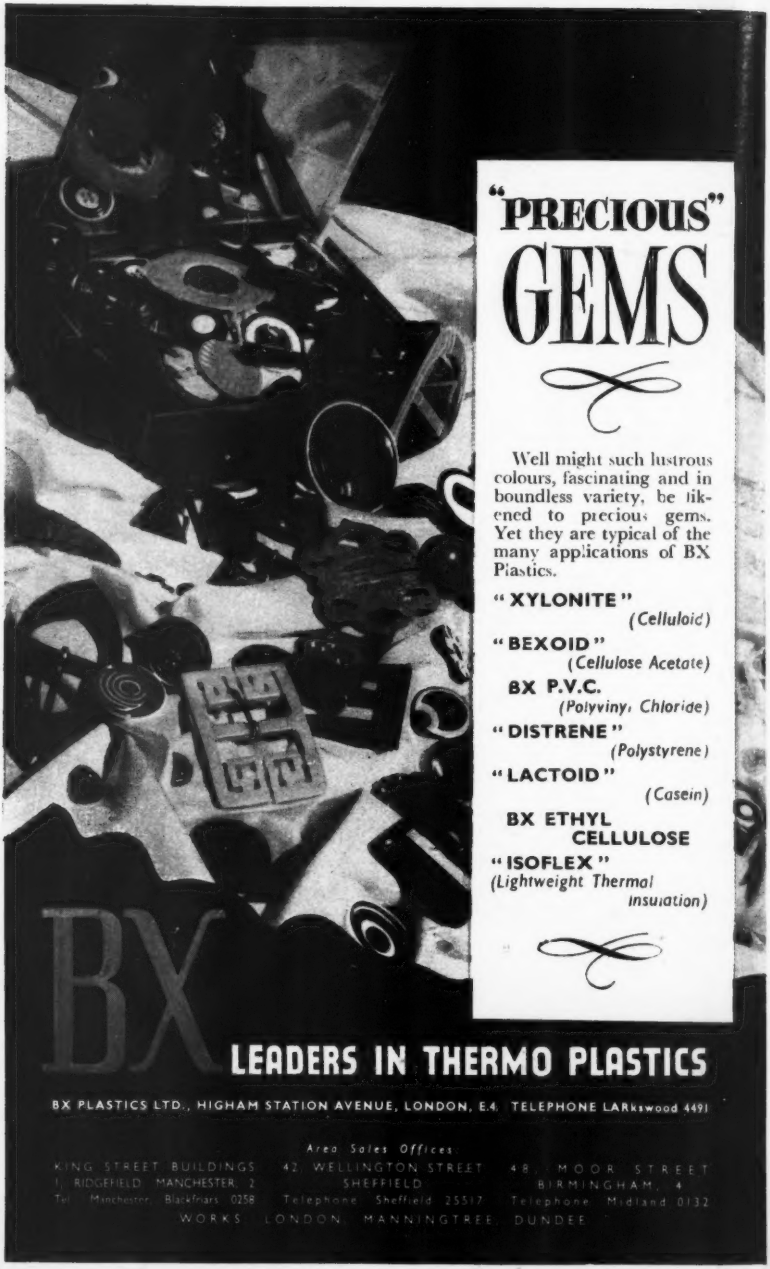
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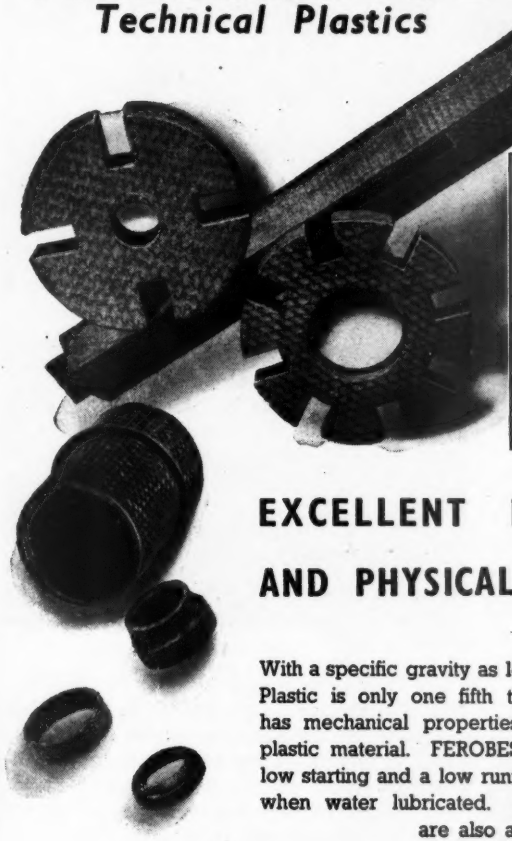
FEROBESTOS

Technical Plastics



Physical & Mechanical Properties of FEROBESTOS

Grade	EF	LA	LF
Base	Asbestos Non-woven	Asbestos Cloth Heavy Weave	Asbestos Cloth Fine Weave
Tensile Strength (lb./sq. in.)	27,000	7,000	12,000
Compressive Strength (lb./sq. in.)	65,000	34,000	42,000
Shear Strength (lb./sq. in.)	18,000	11,000	15,000
Cross-breaking St'gth (lb./sq. in.)	29,000	14,000	19,000
Impact Strength (ft./lb.)	5	2.5	4
Fatigue Strength (tons/sq. in.)	3.75	1.0	2.25
Density (Gm./c.c.)	1.87	1.67	1.74

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FEROBESTOS

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And then this bloke invents this 'ere tool. Doosooter it's called and don't ask me to spell it. Light ! A baby can use it. *You* can use it. You with your legs like a sparrer's and your arms like a couple of bent straws. *You* won't get no bleedin' knuckles. *You* won't go 'ome cryin' for tiredness and fall asleep with your face in your supper. Soft ! That's what you'll be. Just a pore little squiddlum ! I'm sorry for you, son, I am. Straight ! You bin born too late.

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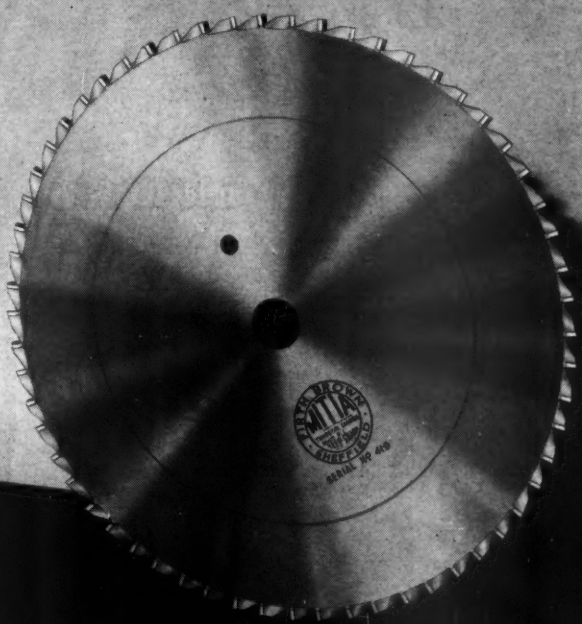

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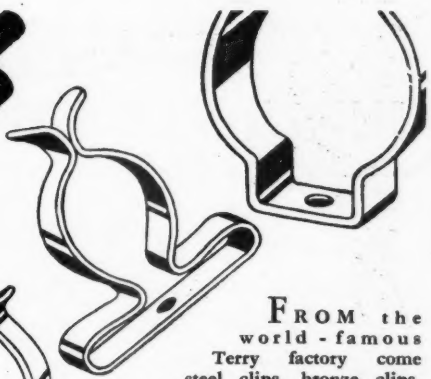

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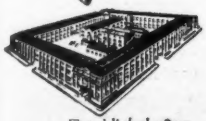

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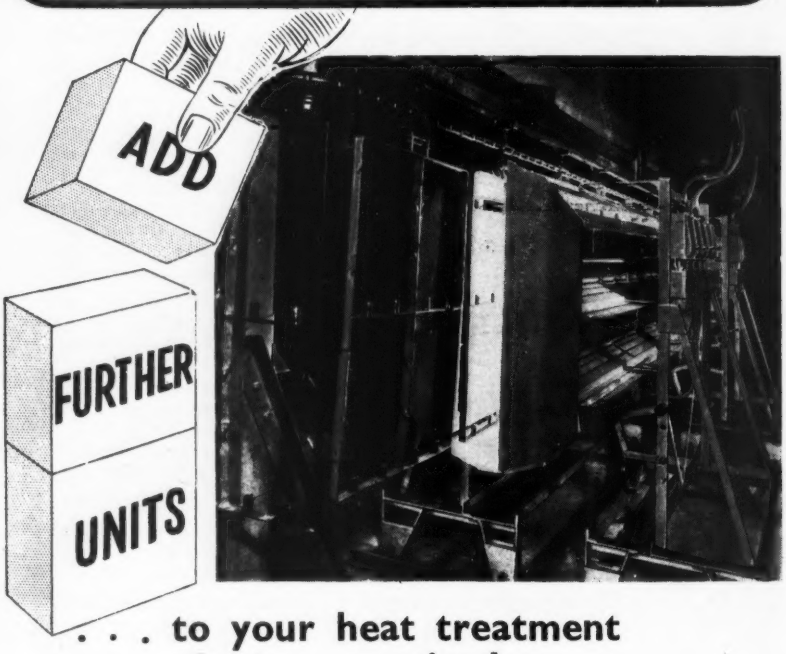

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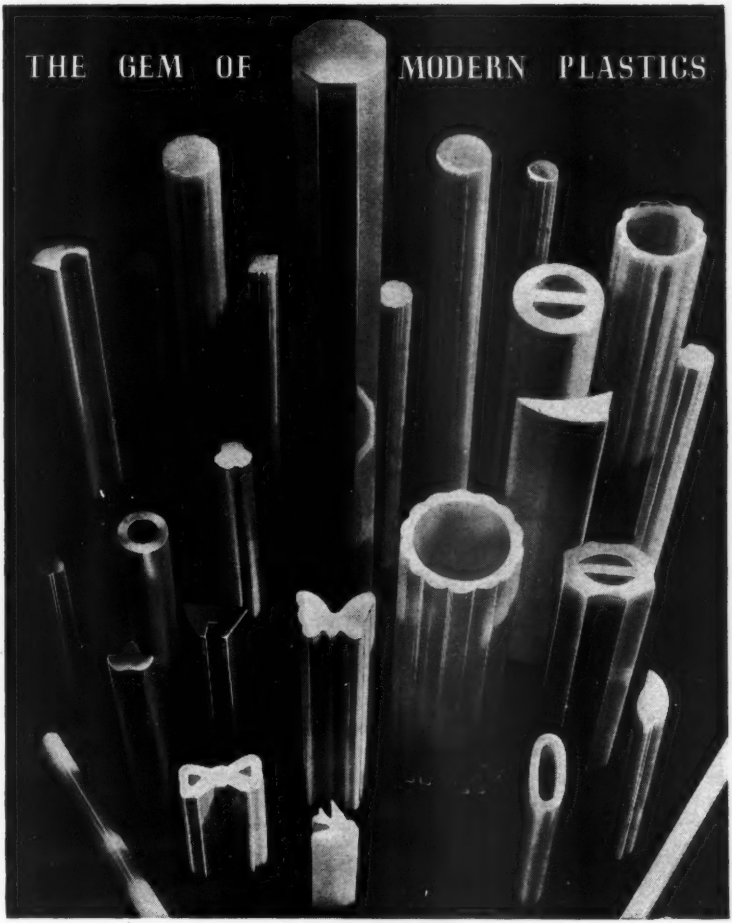

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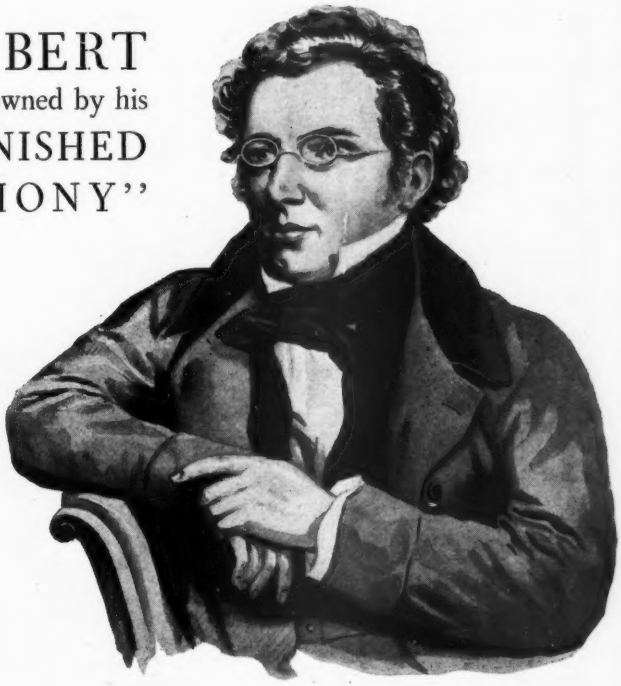

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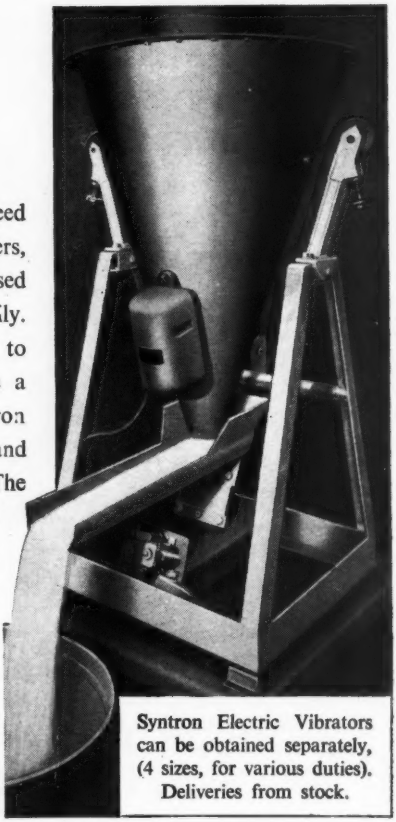

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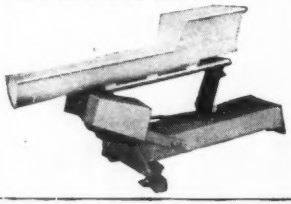

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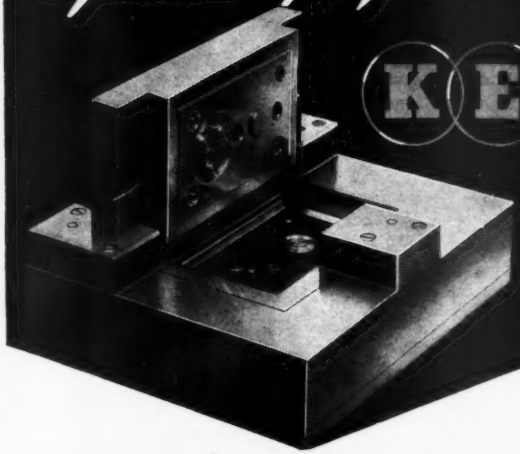

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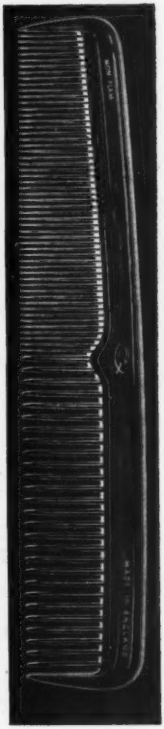

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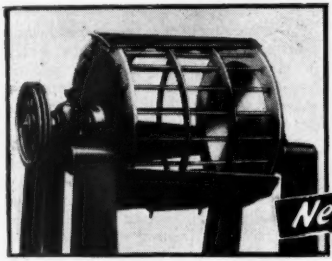

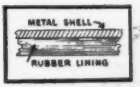

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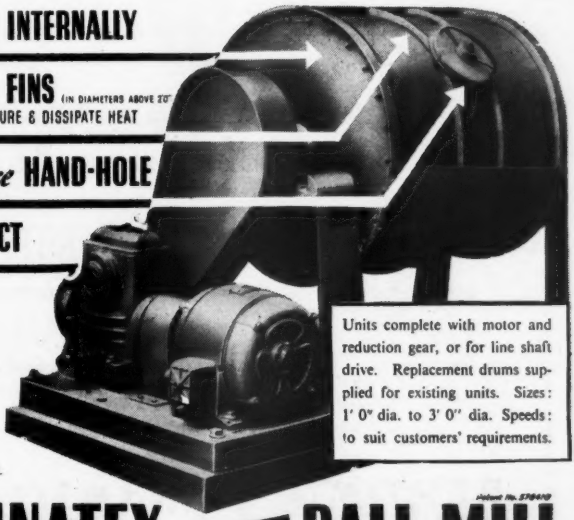

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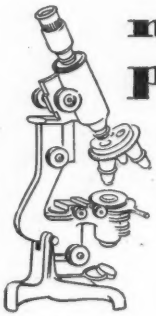

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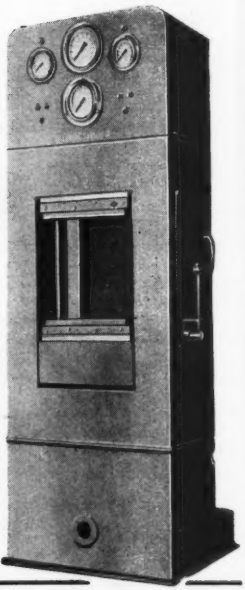

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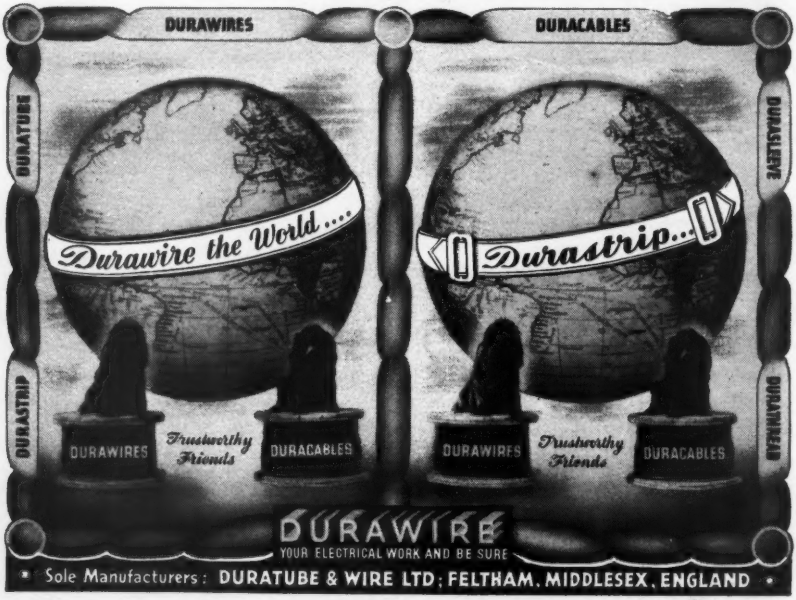

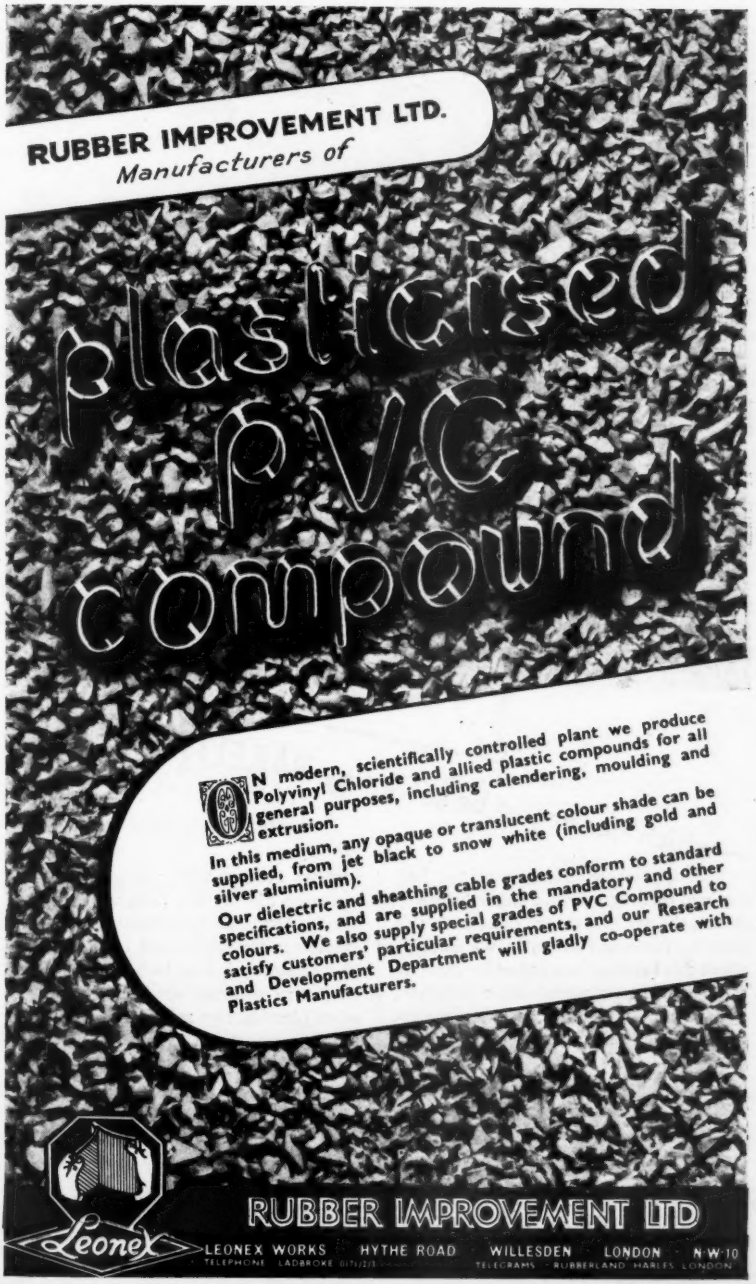
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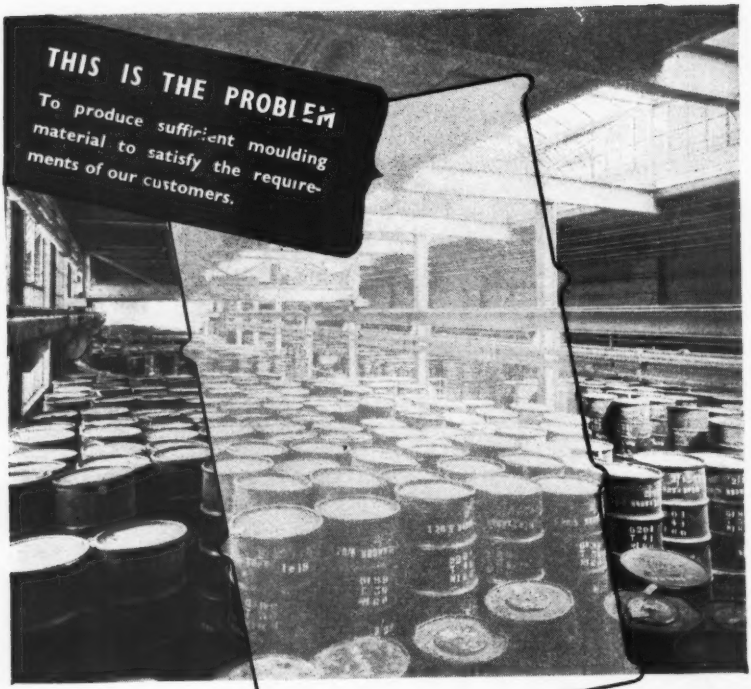

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Plastics

Dealing with the Manufacture, Uses and Potentialities of Plastic Materials

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EDITORIALS

Mark Well!

THE creation of standards, such as are made by the British Standards Institute in this country, is one of the strongest rungs of the ladder up which an industry climbs on its way to recognition, stability and fulfilment. The plastics industry has had plenty of opportunity of realizing the truth of this axiom during the past six years or more, especially in so far as it affected recognition of plastics by the various Ministries.

We are, of course, putting the cart before the horse, since primarily, secondly and all the time, standards exist to assure the customer of the quality of goods he has ordered, but equally, morally and physically, they place an industry considerably higher than its pre-standard condition.

Apart from the type of standard which is a practical and scientific one, controllable in the above instance by customers not without the power of supervision, there is another that is equally necessary to the stability and healthy growth of the plastics industry.

It is a standard to show the public visually that the goods it buys are the best that can be made by the industry, and heaven alone knows that the public is not completely equipped to recognize the best or worst that is available

For many years now the British Plastics Federation, which, in co-operation with the B.S.I., has done so much for the scientific standardization of plastics, has also had this new standard under consideration and is actively considering the launching of it in the form of a Certification Mark clearly identifiable on each moulding that will come within the scheme.

What this Certification Mark is to be, how it is to be applied, and what its effect will be, was told by Mr. Cyril S. Dingley (Director of British Industrial Plastics, Ltd.) to the Midland Section of the Institute of the Plastics Industry on January 6.

As the lecturer stated, the public, on the whole, has little idea of the value of an article and has to rely on the good will or good name of the manufacturer. In the past, large numbers of moulded objects and other plastics have been put on the market of poor quality, imperfectly moulded and unsuitable for the purpose manufactured. The basic idea behind the Certification Mark is to protect the purchaser, and the essential value of the mark is that it should be applied only to articles which will satisfactorily fulfil the functions for which they are made.

In other words, the Certification Mark is, or should be, a guarantee of fitness for purpose.

The feasibility of setting up a similar certification or hall mark scheme is also under consideration in the United States. Mr. Dingley had already been invited to give America such information on what was being done in Great Britain and on the Continent.

Even from the above bare outline of the scheme we must all recognize its importance and the excellent work of the British Plastics Federation in promoting it. We look forward with hope and confidence to seeing its application and the co-operation of all manufacturers and moulders in the industry who have its welfare at heart. By its means and its universal adoption we shall see an end of the use of unsuitable moulding powders, of skimped moulding cures, and of skimped thicknesses, and, contemporaneously, the growth of complete confidence of the public in the products of the industry. The scheme gives protection to the public, but we might also stress the protection it gives to the moulder and the future stability of the industry. Properly enforced, it is one of

the best methods we possess of killing price cutting.

It was obvious from Mr. Dingley's remarks that the matter is not completely simple, that the Federation is learning to walk before it can leap, and that the Certification Mark will be used at first for goods that are clearly defined, relatively simple to control and with which it has had greatest experience. We refer to electrical goods primarily and to those plastics mouldings the "fitness for purpose" of which there is no doubt whatsoever.

Shortages

THE plastics industry is going through one of the unpleasantest periods of its existence, more anxious and onerous than at any time during or since the war. With a capacity and output sometimes more than thrice what it was in 1939, it is now not so much a cry of mould making difficulties, but of shortage of phenol, of urea, of wood flour, of many thermoplastics and, worst of all, of plasticizers. All last year we knew that a shortage meant generally an enormous increase in demand with which neither manufacturers nor moulders could cope. It was not necessarily a decrease in production —indeed there was often an increase. In 1947 we may be faced in some instances with a real decrease accompanied by an ever-increasing demand, more especially from the building industry, since much of the Government's efforts are being turned to that end. There is also the danger of partial or intermittent stoppages due to the coal situation. Almost the only section of our industry that is improving is that of casein, since imports from Europe (for example, from Denmark) are increasing slightly.

This condition of shortage is not unique for every other industry is in desperate need of raw material or labour to carry out its hopes and obligations.

But there is a big difference just the same. In addition to an increase of healthy demand we are receiving the overflow from the older industries which employ the traditional materials of construction and which cannot fully supply the demands made on them. Such manufacturers are turning to plastics often in sheer desperation, to cover in whole or part what they cannot get elsewhere in metals or wood.

Should we be pleased at this change even though the plastics industry can hardly satisfy it? No, for therein lies the seed of much dissatisfaction and disappointment. We are far from having discovered all the proper uses and applications of the oldest of the plastics, and more use will bring new ideas, but it is exactly such conditions that also bring in their trail adoption for purposes totally unfit for plastics. We may sympathize with them in their difficulties, but if they are mentally blind and act merely to safeguard themselves in a temporary shortage we must fight against them. If plastics fail them they will not blame themselves. It will be the plastics industry that will suffer.

Throughout the life of this journal we have urged that no improper use should ever be made of plastics, to a more or less confined audience. To-day all of us should shout it from the housetops.

Technical Papers and the Institute

IT is most agreeable at this stage to turn to other evidence of the growth and stature of the plastics industry, for undoubtedly the quantity and quality of scientific and technical papers read before the Institute of the Plastics Industry is a good barometer, or thermometer if you prefer it, of its condition.

The number of members of the Institute and their attendance at all meetings is amazingly high and their energy at subsequent discussions extremely gratifying. Of the papers read in the past, many have proved of very high merit; others have by no means been so meritorious or at least so useful in these days of urgency. A tightening-up of the selec-

tion of the type of paper to be read is overdue.

It is for this reason that we have read with considerable pleasure a "Memorandum on a proposed method of obtaining papers to be read before the Institute of the Plastics Industry." It has been written by Mr. W. J. Brown, M.I.E.E., one-time chairman of the Northern Section, who knows what he wants, what the Institute should have, and is not afraid of saying so. This is refreshing.

He states quite clearly that the time has come to improve their quality and to secure greater control by the Papers Committee. Many papers read in the past have been too general in character and those which are merely a re-hash of information that has already been published and which is available either in the archives of the Institute or in other literature should not be presented. It is by the reading of original work that the welfare of the Institute is promoted.

Mr. Brown suggests, therefore, that the papers (some eight should suffice during each session) should be obtained by a Central Authority and made available for each section in turn after submission to the Papers Committee, who will decide on their value or appoint suitable persons with special knowledge to help them in their decisions. Mr. Brown also gives details of a system to be carried out to gain this end, and an excellent system it is. It should remove much unnecessary work from the shoulders of local secretaries and so relieve them for more urgent work and fill up some of the lacunæ that have existed.

Perhaps Mr. Brown's ideas may be deemed idealistic. They do seek an ideal, so let us find it. It can be done. As we used to see so often on the desks of many during the late war: "We do the impossible; miracles take a bit longer."

If there is any criticism we could make it is that we do not despise the "general" or rehashed article so much as Mr. Brown does, unless it is foisted off as original. It is often necessary, especially since members are so varied in character and we must link up with outside industry. Furthermore, members have not all the same level of experience, which brings us to the necessity of "Junior Sections," which is another question.

Cabbages and Kings

A HUMOROUS correspondent in "Country Life" bemoans the present price of oysters and puts the blame on the high cost of transport, due no doubt to the weight of the shells. He suggests transferring them into light plastic ones at source (i.e., at bed).

Now here we suggest is an excellent example of fitness for use of plastics except, of course, that the moulded cases should be sown at low tide on the spot at the proper season when the spawn could enter their little homes and settle down to becoming nice and fat and juicy.

Mr. Dogsboddy, our technical man, suggests that the shells should be moulded of transparent or translucent plastic, e.g., polystyrene or polythene, so that those with pearls in them could be removed prior to transport. High-quality plastics would keep them dry on wet days.

New P.V.C. Cloth

To meet the increasingly exacting demands of the garment-making industry, a new material of the P.V.C. family is now to be produced under the name of "Craylene" by the Greenwich Leathercloth Co., Ltd. (St. Mary Cray, Kent). In view of the very considerable production difficulties at present facing the textile world, the availability of "Craylene," which will be in full production in April, is a matter of great interest to the making-up trade. The material is especially suitable for rainwear, curtains, umbrellas and similar goods. Without increase in weight, as compared with the glossy film so largely used for this type of work, "Craylene" is claimed to give greater tensile strength and resistance to tearing; it is matt-finished on both sides and is translucent. Existing plant is stated to be capable of producing 6,000,000 yds. per annum.

Technical experts of the Greenwich organization have been at work in an endeavour to improve the making-up processes and investigations are being made into methods of sealing by systems otherwise than that of high-frequency.

Graphite Aids Electro-deposition of Metals on Plastics

By
A. H. Stuart, Ph.D., B.Sc.

From trials made with many metallic powders the present author has found that the film produced on the surface of plastics is a very poor conductor of electricity. Whilst this may be due to insulating effect of the bonding medium in contact with the metallic particles, there is evidence that these particles do not make adequate contact within the film and thus do not provide a continuous conducting medium.

THE preparation of a film of graphite or other conducting material on the surface of a non-conducting substance, as a preliminary to electro-plating, is best considered under three aspects. The film-forming characteristics of the material employed are of prime importance. These characteristics usually depend upon the bonding medium employed, and since this is not normally a conductor of electricity, it is desirable to use as little as possible. Further, it is obvious that the smaller the particle size of the conducting substance, the thinner the film which can be made, and this reduces the amount of bonding material necessary to hold the film together. Nevertheless, particle size plays a part in the determination of conductivity, although the results of my experiments indicate that the influence is much more complex than has been suggested.*

Graphite has two advantages over metallic powders. The surface of the particles is not subject to oxidation, and, being of a crystalline structure, the particles are more uniform in shape and will pack into the film better, in consequence of which they maintain better contact one with another. The film-forming characteristics of graphite are very good, because the crystalline shape takes the form of flat hexagonal plates; and while the electrical conductivity is anisotropic, it is at a maximum in the hexagonal plane, which naturally aligns itself to a large extent in the plane of the film. The source of much of the electrical resistance of a graphite film will lie not in the individual particles, but in the contacts between each particle and its neighbours. At first sight it might appear desirable to make these contacts as few as possible by making the particles large, but experience shows that large particles exhibit poor film-forming characteristics.

These considerations suggest that there is an optimum particle size which will give the best results. Experiments have proved that this is the case. Trials have been made on a large number of types of graphite, both natural and artificial, in powder form and dispersed in a medium.

While colloidal graphite dispersed in water (Acheson "Aquadag") gives the best films of any graphite so far tried, the electrical conductivity of the film is not so good as that formed from a dispersion of somewhat larger particle size known as "Prodag, grade C." This is a semi-colloidal dispersion of pure graphite, which will maintain suspension in water over a long period. It has good film-forming characteristics and gives a much better conductivity than any other type of graphite so far tested. Graphite powders, of which a great many have been tried, are quite definitely inferior to this dispersion for the purpose of electro-plating.

Although a graphite film formed as described may have a suitable conductivity, it sometimes happens that it does not stand up well to immersion in the electrolyte. Much seems to depend upon the nature of the surface to which the graphite is applied, and there appears to be a tendency in some cases for electro-deposition of the metal to take place—partially, at any rate—under the graphite film and so push it off the matrix.

*Ollard and Smith, Deposition of Metal on Plastics. "Plastics," September, 1946 (page 470), and following issues.

A very satisfactory remedy for this trouble has been found in the addition to the Prodag dispersion of about 3 per cent. of an emulsion of cresol-formaldehyde. For purposes of electro-deposition, Prodag, grade C, can now be obtained with this emulsion already incorporated. When permissible, it is an advantage to bake the film for a few minutes, but in all cases it is essential that the film should be given time to get thoroughly dry before plating is attempted.

General Procedure

Copper is the best metal for the initial deposition and it is desirable that this film should, in the first instance, be as fine grained as possible. Such a film provides a suitable base for the deposition of another metal, or more copper may be deposited, using a higher current density for obtaining a heavier deposit, as in electro-forming.

With materials such as glass and porcelain, and certain plastics, the procedure is simple. The graphite dispersion is applied by means of a soft brush; alternatively a spray gun may be used. It is essential that the surface on which it is desired to deposit the metal should be completely covered by the graphite, hence brush marks and bubbles should be avoided. A second coat of the graphite dispersion should not be applied; if the first application is not satisfactory, it should be washed off and a new start made.

When the film is dry it should, if possible, be baked for a few minutes at a temperature of 130 degrees C. or thereabouts. This renders the graphite film relatively waterproof and improves the electrical conductivity. It is now ready for the plating bath. The following bath has given good results:—

Copper sulphate crystals	24 oz.
Pure conc. sulphuric acid (s.g. 1.82)	4 fluid oz.
Phenol	0.075 oz.
Distilled water	1 gallon

Phenol, introduced as phenol sulphonic acid, promotes a fine grained deposit. It should be dissolved in a little of the conc. sulphuric acid, before the latter is added to the bath. Slight heat may be necessary to dissolve the phenol, in which case the solution should be allowed to cool before adding it to the bath. The bath should be operated cold, about 15 degrees C. being a suitable working temperature.

It is important that the current density should be very low at first; from 1½ to 2 amps. per sq. ft. has been found suitable in most cases. As soon as the whole surface is covered with copper, the current density may be increased, but it is best to do this in stages rather than in one step, and for this purpose it is convenient to have a rheostat in the circuit. The following notes deal with difficulties which have arisen in the course of the author's work.

Surfaces Which Resist Wetting

Some substances are not easily wetted by water or a water dispersion of graphite. Examples of this will be found in "Perspex" and cellulose acetate. Until this resistance to water is overcome, it is impossible to obtain a satisfactory film of graphite on the surface. Many wetting agents have been employed, but none has given satisfactory results. The following treatment, however, has proved successful: Place a few drops of the graphite dispersion on the surface with a swab of cotton wool or similar material and smear the liquid over the surface, wiping off any superfluous moisture so as to leave only the thinnest possible film. When this is dry, the dispersion may be applied in the ordinary way without difficulty.

Plastics Not To Be Baked

Many of the plastics now in use are not suitable for baking at a temperature of 130 degrees C. In such cases, proceed as before, but instead of baking, allow the graphite film to dry very thoroughly. If admissible, 24 hours in a warm atmosphere (about 25 degrees C.) will be sufficient, but if even this amount of heat is undesirable, at least 48 hours at room temperature should be allowed. In most

cases, plating may now proceed as described above.

Surfaces Which Cause Blistering

It occasionally happens that substances which have not been baked will develop blisters in the film as soon as it is immersed in the electrolyte. In such cases the graphite film, after it has been dried thoroughly, should be rendered waterproof by a very thin application of a 3 per cent. solution of Seekay wax (grade A.93) in benzene. This will overcome the trouble, and the normal plating technique may be applied.

Treatment of Porous Surfaces

Porous surfaces may absorb the graphite dispersion to a very wasteful extent. This may be overcome by giving the surface a dressing of a solution of gelatine. In this way the pores will be filled up and if a little potassium bichromate is incorporated, the action of light will render the gelatine insoluble in water and thus prevent the gelatine affecting the subsequently applied graphite dispersion. It is convenient to use a 2 per cent. solution of gelatine with about 0.5 per cent. of potassium bichromate added. In cold weather it may be necessary to warm this solution to render it sufficiently liquid, but having been warmed it will remain liquid for several hours. It should be allowed to dry thoroughly before applying the graphite, and no more than necessary to seal the pores should be used.

Some Causes of Bad Adhesion

Many fibrous materials expand or contract when wetted with water; paper is a common example. If a water dispersion of graphite is applied to the surface of paper the latter will curl, owing to the wetted surface expanding more than the opposite surface. This may be prevented by wetting both sides of the paper at the same time, but, for reasons given below, electroplating on paper treated in this way is not satisfactory. The only solution to this problem is to impregnate the fibrous material with a water resisting resin, so as to render it sufficiently waterproof to prevent it changing its form when immersed in the electrolyte.

It would be unreasonable to expect the adhesion of an electro-deposited metal on a film of graphite to be equal to that where metal-to-metal contact has been established, since the resistance to shear cannot in any case be greater than that offered by the graphite film itself. The commonest cause of bad adhesion, apart from using too high a current density in the early stages of the deposit, is faulty wetting of the surface by the graphite dispersion. This aspect of the problem has been dealt with above. But there are other causes, of which the case of paper is an example.

Untreated paper may be graphited and electro-plated without difficulty, but on drying the film of metal is dislodged. This is due to the fact that the copper film fits the wet paper and, as drying takes place, the paper shrinks and the copper film does not. Hence a shear force of some magnitude is set up. In the case of paper and other fibrous matter, impregnation with a suitable resin meets the case, but with some substances a remedy appears to be more difficult. For example, some plastics have a thermal coefficient of linear expansion nearly ten times that of copper; thus any substantial change of temperature may set up thermal stresses sufficient to dislodge the film. Flexible material may also give trouble, since electro-deposited copper has not the flexibility of annealed sheet copper. Adhesion in such cases may sometimes be improved by providing an anchorage for the metal film by such means as sand-blasting the surface before applying the graphite.

Institute of the Plastics Industry

As from February 15, 1947, the address of the Institute of the Plastics Industry will be: The Adelphi, Adam Street, Strand, London, W.C.2. (Telephone, Temple Bar 3632.)

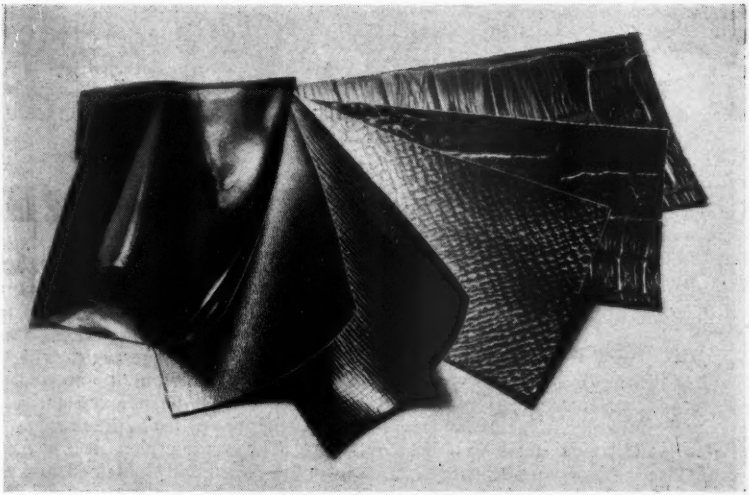
Book Reviews

Dictionary of Plastics. Compiled by Paul I. Smith. Pp. 168. Hutchinson's Scientific and Technical Publications; 15s.

This is a handy reference book for raw-material manufacturers, moulders, fabricators and others who need facts concerning plastics. The information is presented concisely and is not concerned with materials alone; there are numerous references by name to technique, equipment and all other directions of inquiry in the plastics industry. The definitions given are necessarily condensed, as befits a dictionary distinct from an encyclopædia. There is no attempt to supplant the existing reference books, but certainly to supplement the information which they alone provide. With rapidly changing developments within the plastics industry, there appears to be a definite future for a book of this type, and the compiler is to be congratulated on his present achievement, for the compiling of such a dictionary must involve a good deal of common drudgery in collecting and sifting the facts, prior to condensing them for publication. Regarding registered trade names, the references selected for insertion are those mainly concerned with products rather than manufactured goods; there has been no attempt to make this dictionary a trade reference book. Any overloading of the pages with trade names would have defeated the object in view, which has been to bring facts to those who contact the plastics industry, or are directly engaged, rather than provide clues to sources of supply for mere merchants and manufacturers' agents.

Plastics Handbook for Product Engineers. Compiled and edited by John Sasso. Pp. 468. McGraw-Hill Book Co., Inc.; 30s.

This book contains specific information on all types of plastics. It tells the reader how to select the right type for a given application; in this, the book should prove invaluable to the designer and engineer in search of the necessary facts to achieve the successful combination of materials with new product designs. There is much that may be learned regarding the processing, machining and finishing of plastic parts, as also upon details of design such as tolerances, wall thickness, inserts, threads and fastening. The chapter on Design Details (13 pages) is short yet concise, but ably illustrated. Another chapter (14 pages) which will be read profitably concerns common faults in moulded parts, their causes and remedies; here the subject is treated in separate sections for (a) phenolics and ureas—compression moulding, (b) cellulose acetates, polystrenes, and vinyl materials—injection moulding, (c) cellulose acetates and vinyl materials—compression moulding, and the facts of condition, *probable* cause, and *possible* remedy are tabulated in three convenient columns. The introductory chapter, covering the chemistry of plastics, is illustrated by a series of diagrammatic flow sheets to supplement a concise account of the chemical background of plastics. This chapter, as also that upon synthetic rubber-like materials which occurs towards the end of the book, has been prepared by Paul O. Powers, of the Battelle Memorial Institute. Specific synthetic rubbers are dealt with by technicians of the B.F. Goodrich Co., E.I. du Pont de Nemours and Co., Standard Oil Company of New Jersey, Thiokol Corporation, and Hycar Chemical Co. The discussion of fundamental design considerations is taken from a series of articles by W. S. Larson, of the plastics department of the General Electric Co., which originally appeared in "Product Engineering." There are some oversights in editing; for instance, Table 51, giving a summary of values regarding the chemical resistance of various plastic materials, does not clearly show what materials are under consideration. The numerous tables of data form an important feature of the book.



PLASTIC "LEATHERS"

IT is inevitable, it seems, whenever we manufacture a material that simulates leather or is used in place of it, that it shall be called imitation, artificial or synthetic leather, as the mood takes us, although structurally, at any rate, the description is quite wrong. We have never seen a good imitation that anywhere approaches the fibre "build-up" of the natural skin.

Nevertheless, in spite of the excellence of the best leathers, and because of the existence of the not-so-good, of variation in qualities, of attack by fungi, of deterioration, of high wastage, of size limitation, and finally of periodic inadequate supplies, the artificial substitute has often reached a stage where it is used in preference to leather and loses little or no face in comparison. The nitrocellulose type, of which we believe the well-known "Rexine" is an outstanding example, has been so consistently improved during its long lifetime that little distinction can be made in its value as compared with that of natural leather.

As we indicated in our September, 1946, issue, we have encountered a new synthetic type of sheet which is now being manufactured in France, and which is widely used there for the manufacture of handbags, etc. In sending us the samples shown in the above photograph, the manufacturers, Etablissement Coria, of Paris, stress its value for most normal applications, especially for the upholstery of armchairs and other furniture and uppers for shoes.

The sheets, some 15-18 thousandths of an inch in thickness, are cast on to plates and then embossed with an engraved plate. We have seen similar material made from phenol-furfuraldehyde resin, modified or plasticized with a poly-vinyl compound, and this may be of the same general structure.

Obviously, it can be given the surface appearance of any leather, but its main attribute, in addition to its excellent wearing properties, is its amazing strength, which must be much higher than that of leather. Exerting all the tearing power of our nails we were quite unable to produce any semblance of a tear. From the strength point of view this is the best we have yet seen.

F

Recent Progress in the Welding of Thermoplastics

By
G. Haim and H. P. Zade

DEVELOPMENTS in the welding of thermoplastic materials were last reviewed in "Plastics" in October, 1945[1]. A great deal of further work has been published since and the present review endeavours to bring to the notice of the reader the latest information on this subject.

Gas Welding

First of all, it appears to be necessary to correct the statement previously made that gas welding of thermoplastics originated in Germany. Extensive literature research has revealed that R. C. Reinhardt, of the Dow Chemical Co., applied for a patent for his method of welding thermoplastic materials, and from the date of his application (November 20, 1937) it is obvious that his invention preceded that of Henning (Ger. Pat. 739,340) dated May 1, 1938. No other information, however, is available on any further development of this process by Reinhardt.

U.S. Pat. 2,396,968 by Phillips, assigned to The Udylite Corporation, describes a gas torch which is a slight improvement on types previously patented by the same inventor.

A gas welding torch which should have a considerable appeal to welders on account of its light weight has been put on the market recently by Rockweld, Ltd. It operates on acetylene and has the further advantage that only two connections have to be made, one to the acetylene supply and the other to the nitrogen cylinder.

A disadvantage of the gas welding technique is the very slow rate of deposition; the welding speed usually does not exceed two inches per minute. A special technique developed by the laboratories of I.C.I. Plastics permits welding speeds up to five inches per minute. This is achieved by employing a filler rod containing approximately 12 per cent. of polyisobutylene. Contrary to normal practice this filler rod is held at an angle of 45 degrees, whilst the welding torch is also held at the same angle. The filler rod is rotated between thumb and first finger of the left hand, and torch and filler rod are operated in the same vertical plane. The resulting deposit is shallower than the one usually obtained and does not look so neat, but the strength of the weld is very often considerably greater.

The repair of ebonite containers for storage batteries by hot air welding with Vinidur filler rods is described in a paper by Schrader[2].

Fabrication and installation of chemical plant in thermoplastic materials has been started on a considerable scale in this country recently. Alkathene (polythene) is a most valuable material for such fabrication, as it withstands attacks by corrosive chemicals very well. Extruded polythene pipes up to 1½ ins. bore are a standard product of the Telephone Construction and Maintenance Co., Ltd., and pipes up to 2 ins. bore will soon be on the market. This type of pipe is being installed in a spinning plant for a rayon factory and in a number of chemical works. Fabrication of these pipes by gas welding has been taken up by Rockweld, Ltd. The installation of pipelines usually requires valves of a corrosion resistance equal to that of the pipes. Fig. 1 shows an all-plastic 1-in. bore Alkathene valve fabricated by welding.

Heated Tool Welding

A welding machine for the joining of plastic pipes is described in U.S. Pat. 2,384,014 by Cutter. Heating is effected

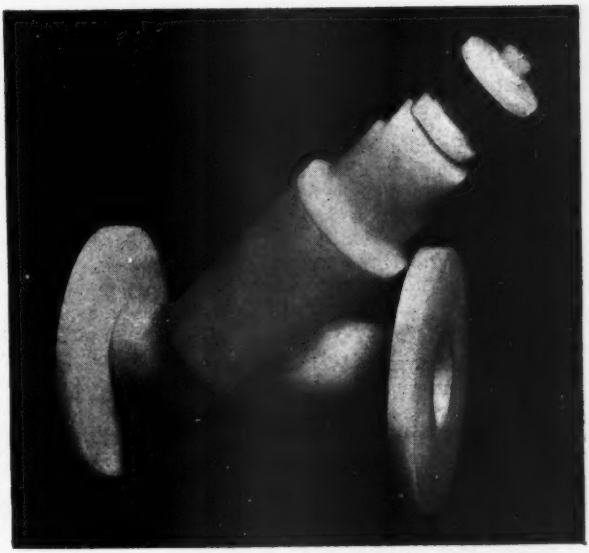


Fig. 1. — All-plastic Alkathene valve, 1-in. bore, fabricated by welding. (Courtesy of Rockweld, Ltd.)

by electrical resistances. Railton of Ideal Packagings, Ltd., obtained a British patent (579,147) for a heat sealing machine which consists of two jaws at least one of which is heated; the jaws can be closed by means of an electro-magnet.

British and American practice in the manufacture of artificial eyes is described in the literature. It is of interest to note that the assembly of the methyl methacrylate parts of such eyes is effected by heated tool welding.

Although it seems to be common practice in this country to weld pouches and bags by the high-frequency method, heated tool welding is used on a considerable scale in the United States for the same purpose. U.S. Pat. 2,379,500 and 2,389,560 by Steffens, and U.S. Pat. 2,392,848 by Gilfillan, describe the welding of pouches by this latter method. A more complicated machine for the same purpose was invented by Billeb (U.S. Pat. 2,380,914) and a machine for continuous heat sealing operations is disclosed in U.S. Pat. 2,392,695 by Rohdin.

The manufacture of raincoats and industrial protective clothing has often been attempted here and in America by high-frequency seam welding. From all that is known, this method has never been employed in Germany, where extensive use was made of plastic garments. These were heat sealed by special "sewing machines," one of which is described in Ger. Pat. 732,156 by Pfaff and Eckhard. A somewhat similar machine was invented by Custers (Ger. Pat. 741,755) (U.S. Pat. 2,387,566), but judging from the description in the patent specifications it seems that the Pfaff machine is the more practical proposition.

The manufacture of sheets from polystyrene foils by stacking a plurality of foils together and welding them under the application of heat and pressure is described in Brit. Pat. 579,551 by Nicholas. Polystyrene tubes are made by winding foils over a mandrel in such a way that the edges overlap. Welding is subsequently carried out by heating mandrel and tube; pressure is applied simultaneously.

A very ingenious method for the assembly of bundles of threads or filaments of cellulose acetate or polyvinyl-

chloride is disclosed in Brit. Pat. 579,015. Such bundles are cut by hot wires or knives and thus fused together at one end. Applications mentioned are polishing and buffing wheels, carpets and upholstery.

Friction Welding

This fascinating method was first demonstrated to the public by Freres[4, 5, 6] of the Rochester Button Co. at a meeting of the Society of Plastics Industry at Manchester, Vt. However, the process requires a fair amount of tooling and is therefore only likely to be used for mass production.

High-frequency Welding

Methods and machines for the high-frequency welding of thermo-plastic materials have met with many improvements. These are concerned partly with welding technique and partly with the development of materials with improved weldability.

Discussing first the progress made in the design of seam, jig and press welding machines, the most noteworthy features shall be mentioned in the following order.

Seam Welders

The main difficulty found with roller-type seam welders is based on the fact that a machine working at constant speed is of very little use in industrial practice. All the applications in the clothing trade demand a machine with infinitely variable speed; the speed should compete favourably with that of standard sewing machines.

In order to achieve this with a roller-type machine it is necessary to relate speed and high-frequency output in such a manner that a decrease in speed is instantaneously coupled with a decrease in high-frequency energy and vice versa. When the machine is stopped suddenly the high-frequency power must be reduced to zero, otherwise flashing through the material and arcing will occur.

Various suggestions have been made to solve this problem.

In U.S. Pat. 2,391,086 by the Compo Shoe Machinery Corporation a device has been patented which makes the motor speed follow the high-frequency output instantaneously by means of an electronic circuit using a grid-controlled rectifier valve.

The problem was solved in an entirely different way by the Singer Corporation in America,[7] who replaced the rotary live electrode with a reciprocating bar and used a drive mechanism similar to that of a sewing machine. Feeding of the material to be welded is effected by the motion of the bottom electrode which has an oscillatory drive synchronized with the movement of the reciprocating bar electrode. The bar electrode descends (probably under spring loading) and high-frequency current is passed through the material after pressure has been applied. Contact is broken before the electrode lifts; the length of the electrode is approximately $\frac{1}{4}$ in. and it is possible to weld curves of comparatively small radius in the form of a succession of short straight lines.

The Radio Corporation of America[8] in co-operation with The Union Special Machine Co. have produced a machine of the roller type for which rather high working speeds are claimed. Only a general description of this machine has been published, and nothing has been reported so far about the possibilities of varying the speed of this seam welder, which is also the subject of Brit. Pat. 573,518.

Several firms in this country are working on improvements of the roller-type machine, and the trend of development goes towards very much higher frequencies than have been used up to date. In this connection a recent publication should be mentioned[9] which describes the use of a wave guide and Radar Frequencies for dielectric heating.

Spot and Jig Welders

Quite a number of these machines have been put on the market recently. "The Diaplastics spot welder with a large work-table incorporating a 300 watt 50 megacycle oscillator in the structure of the table was described in the 'Machinist.'"[10]

Murphy Radio, Ltd., designed a spot

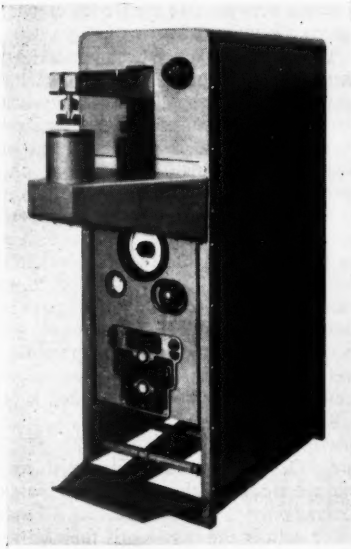


Fig. 2.—Jig welder, with projecting insulated bottom electrode (Courtesy of Rediffusion, Ltd.).

welder which works in conjunction with a 2 k.w. 30 Mc/s oscillator.

Rediffusion, Ltd., are marketing a jig welder (Fig. 2) which incorporates a 350 watt 30 Mc/s oscillator. In contradistinction to other models, this machine does not have a work table, but is fitted with a projecting insulated bottom electrode. The absence of a work table in this case permits better access to the bottom electrode and facilitates the welding of such articles as lamp shades, belts and the like. The top electrode is mounted on a metal arm by means of a universal joint. Movement of the arm is arcuate.

All these machines can be fitted with various sizes and shapes of electrodes so that either spot welds, straight lines or contours of different shapes can be produced.

A spot welding device in the form of a "gun" is described in Brit. Pat. 572,292 and 572,443 by the Radio Corporation of America.

Press Welding Machines

British Insulated-Callender's Cables, Ltd., have developed a machine for the purpose of joining p.v.c. sheets and strips. The output of this machine is 500 watts at 30 Mc/s.

Diaplastics, Ltd., have shown their press welder at a recent exhibition.[10] The welding press is mechanically operated (toggle system), and the output of the generator is approximately one kilowatt.

Rediffusion, Ltd., have developed a pneumatically operated press welder which is capable of welding articles up to an overall size of 18 by 12 ins. In order to ensure the safety of the worker, the press is operated by means of a deadman valve in conjunction with a two-way control valve; i.e., it is impossible for the operator to put either of his hands into the danger area while the press is working.

The Thermatron Division of Radio Receptor Co., in America, have developed a pneumatic type of press welder

which has been shown with illustrations in a recent publication.[11]

The features of this machine are rather similar to those of the last-mentioned welder.

Brit. Pat. 580,374 (British Insulated Cables) describes a heating or welding press for dielectric materials, which is designed in the form of a cavity resonator and should therefore not be susceptible to power changes in the case of changes of platen distance and capacity due to softening of the interposed materials.

In conclusion it should be mentioned that spot, jig and press welders are nowadays always fitted with mechanical stops which prevent undue compression of the welding seams. In some cases these stops are also used to switch off the high-frequency current whenever a predetermined gap between the electrodes has been reached.

New Welding Methods

The following new methods can be reported here:—

Haim and Zade describe in Brit. Pat. 574,656 and 574,657 an apparatus for the high-frequency welding of flanges to plastic pipes and the welding of such flanged pipes. Brit. Pat. 574,139 by British Insulated Cables shows a new device for the repair of cable coverings by means of high-frequency welding.

Stephens and Steel (I.C.I., Ltd.) describe in Brit. Pat. 577,997 a method for the manufacture of tubes from thermoplastic sheets. According to the specification an inner mandrel is used as one electrode; a thermoplastic sheet is wrapped around this mandrel and an outer electrode in the form of a split sheath is applied. The field between these concentric electrodes is used to weld a solid tube from the layers of wrapped plastic material.

Brit. Pat. 581,181 (Haim and Zade) describes the use of high-strength dielectric materials for the covering of one or both of the welding electrodes of a press welder. The purpose of this arrangement is to prevent flashing over in the air spaces left between adjacent articles to be welded simultaneously when these are inserted between flat electrodes extending across a number of articles.

The welding of sheet material of extremely low dielectric loss (polythene and polystyrene) has been made possible by a heat transfer method. Inserting the sheets to be welded between sheets of a high-loss material (for instance, p.v.c.) and exposing this "sandwich" material to an h.f. field between electrodes results in heating the high-loss material and in a transfer of heat from the high-loss to the low-loss material, thus effecting a weld between the sheets of low-loss materials. Due to the chemical inertness of polythene and polystyrene, it is possible to peel off the p.v.c. sheets subsequently as they do not adhere to the welded sheets.

British Insulated Cables have perfected this method (Brit. Pat. 577,474, 577,719 and 577,720) by covering the surfaces of the electrodes with a high-loss material such as polyvinylidene chloride. A further refinement is the coating of the electrode surfaces with a layer of foamed high-loss material, the purpose of this being a reduction of heat losses from the welded seam to the cold metal electrodes.

An improvement in polythene films which may have a considerable effect on future development in welding is described in Brit. Pat. 581,717 by Myles and Whittaker (I.C.I., Ltd.). The subject matter of this patent is a polythene film chlorinated on both surfaces. The loss angle of the chlorinated surface is approximately one hundred times that of the remainder of the film. According to the patent specification high-frequency welding of such film has been successful.

In general it can be stated that the quality of calendered film as well as extruded strip has been greatly improved.

Good progress can also be reported in the provision of printed p.v.c. sheet, and a large number of very attractive designs have been produced either by the screen printing process or by other methods. Such sheets are now welded extensively.

The welding of materials such as rigid cellulose acetate in sheet form presents considerable difficulties. This is partly due to the comparatively low dielectric

strength of the material, but even to a larger extent to the fact that these rigid materials with low plasticizer content do not soften very readily and flow only under the application of extremely high pressures. Copolymerization helps considerably in this respect, and there are signs that copolymers of vinyl chloride-vinyl acetate will be available commercially in the near future.

PATENT LIST

British Patents

G.W. = gas welding.
H.F. = high-frequency welding.
H.T. = heated tool welding.

572,292, Radio Corporation of America, high-frequency spot, H.F.

572,443, Radio Corporation of America, welding gun, H.F.

573,518, Radio Corporation of America, high-frequency seam welder, H.F.

574,139, Jones and Mills and British Insulated Cables, Ltd., repair of cable coverings, H.F.

574,656, Haim and Zade, welding of flanges to pipes, H.F.

574,657, Haim and Zade, jointing of flanged pipes, H.F.

577,474, 577,719 and 577,720, Quayle and Jones and British Insulated Cables, Ltd., improvements in the covering of welding electrodes with high-loss dielectric material, H.F.

577,997, Stephens and Steel and I.C.I., Ltd., manufacture of tubes by welding of sheets, H.F.

579,015, British Celanese, Ltd., welding of cellulose acetate and p.v.c. filaments, H.T.

579,147, Railton and Ideal Packagings, Ltd., press welder, H.T.

579,551, Nicholas and BX Plastics, Ltd., welding of polystyrene film, H.T.

580,374, Quayle and Jones and British Insulated Cables, welding press (cavity resonator), H.T.

581,181, Haim and Zade, interposed high-strength dielectric, H.F.

581,717, Myles and Whittaker and I.C.I., Ltd., chlorinated surface on polythene, H.F.

German Patents

732,156, Pfaff and Eckhard, heated wedge sewing machine, H.T.

741,755, Custers, heated wedge sewing machine, H.T.

U.S. Patents

2,220,545, Reinhardt and Dow Chemical Co., gas welding of plastics, G.W.

2,379,500, Steffens, method of making joints, H.T.

2,380,914, Billeb and Milprint Inc., manufacture of pouches, H.T.

2,384,014, Cutter-Thomson-Gibb and Electric Welding Co., pipe welding apparatus, H.T.

2,387,566, Custers, seam welder, H.T.

2,389,560, Steffens, apparatus for making joints, H.T.

2,391,086, Crandell and Compo Shoe Machinery Co., power control of H.F. seam welders, H.F.

2,392,695, Rohdin, heat-sealing apparatus, H.F.

2,392,848, Gilfillan and Shellmar Products Co., heat sealing apparatus, H.T.

2,396,968, Phillips and Udylite Corporation, gas torch, G.W.

REFERENCES

(1) *Haim, G., "Recent Progress in the Welding of Thermoplastics," "Plastics" (London), Vol. 9 (1945), No. 101, pp. 496-503.* (2) *Schrader, W., "Reparatur von Hartgummi Akku-Kästen durch Heissluftschweissung," "Autogene Metallbearbeitung," Vol. 37 (1944), No. 23/24, pp. 209-210.* (3) *Anon., "British and American Practice in the Manufacture of Artificial Eyes," "British Plastics," Vol. 18 (1946), No. 211, pp. 560-564.* (4) *Freres, R. N., "Fabricating with Frictional Heat," "Modern Plastics," Vol. 23 (1945), No. 3, pp. 142-145.* (5) *Freres, R. N., "Fabrication of Thermoplastics by Frictional Heat," "Industrial Plastics," Vol. 1 (1945), No. 7, pp. 16-20, 28.* (6) *Freres, R. N., "Plastic Welding Through Frictional Heat," "Canadian Plastics," Vol. 3 (1946), No. 10, pp. 16-18.* (7) *Anon., "Singer Heat Sealing Machine," "Rubber Age," N.Y., Vol. 59 (1946), No. 6, p. 702.* (8) *Anon., "A New Electronic Heat Sealer," "Modern Packaging," Vol. 19 (1946), No. 9, pp. 120-121.* (9) *Anon., "Electronic 'Blow Torch' May Revolutionize High-Frequency Heating," "Industrial Heating," Vol. 12 (1945), No. 11, pp. 1902-1904.* (10) *Anon., "Diaplastics Electronic Welder for Plastics," "Machinist," Vol. 90 (1946), No. 37, 21/12/46, pp. 1487-1488.* (11) *Kohler, F., "Heat Sealing Plastics Films," "Plastics" (Chicago), Vol. 5 (1946), No. 6, pp. 50, 52, 55, 91-93.*

High-frequency Welding Goes Ahead

SOME short time ago we made a remark about the rarity of high-frequency welding of thermoplastics in this country. It would not be surprising if this were so because the method is still in its infancy and because the field to which the process can be applied is not readily recognized by outside manufacturers.

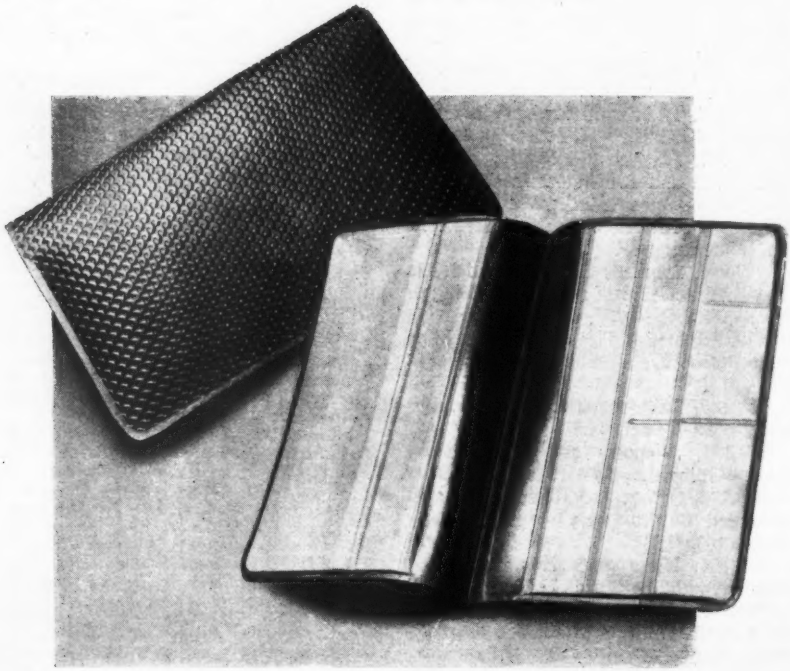
Latest evidence received shows that it is not so rare as we imagined. The welded macintosh is, in fact, in actual production and we hope to refer to it at a later date.

More recent still is the wallet shown in the illustration below. Here the transparent lining which serves as the note-case is welded to the $\frac{1}{16}$ in. thick black p.v.c. backing. In addition the lining itself is welded horizontally and vertically to form the pockets.

The welding work has been carried out by D. and D. Plastics, Ltd., of 20, Beauclere Road, London, W.C., a new-formed concern with much experience in high-frequency methods. The result is a very praiseworthy job, very strong yet soft to handle.

Much credit is due to the suppliers of the raw material, Erinoid, Ltd., Lightpile Mills, Stroud, who have "moulded" the lovely surface. The design is outstanding because it is completely original, making no attempt to imitate leather. It is pleasing to record this tendency to reproduce designs possible only in plastics.

If we may make a general remark, it is this type of high-class work that will increase the reputation of the industry in this country and in the export market, and is long overdue.

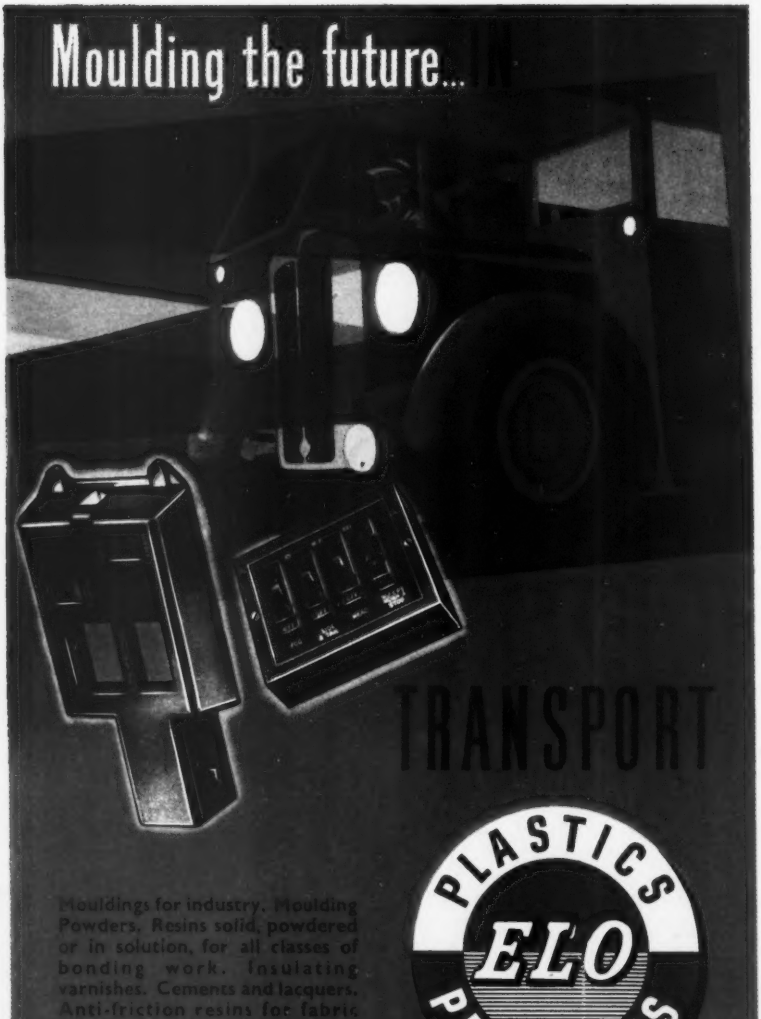


Plastics from I.C.I. are getting about. Nylon monofilament casts are going fishing in ever-increasing quantities. Anglers expect great fish of this piscatorial innovation—and get them.

ICI

P.243

Moulding the future...



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High-pressure laminates have established an enviable 30 years' record. C. A. Breskin sees an extensive use of them in public and private housing. Lower costs seem to be possible with newly developed core materials. New laminates can even be adapted to compound curves. ("Scientific American," 1946/Dec./249.)

Transfer moulding is especially suitable for following factors in mould design: Fragile inserts, high dimensional accuracy, and low original mould costs. W. F. Robb presents design data, advantages and limitations of this process, as well as the characteristics of the finished product, in an illustrated article. ("Product Engineering," 1946/Nov./129.)

Production technique in principle is generally the same in the preparation of low-pressure moulding or laminating materials as when producing high-pressure materials, according to T. N. Noble, in a paper presented to Society of Plastics Engineers. ("Product Engineering," 1946/Nov./138.)

Sanding recommendations for the various types of plastics on the market have been prepared by Behr Manning Corporation in conjunction with Society of Plastics Industry Inc., and are published as a reference sheet. ("Machinist," 1946/Dec./1479.) Difference between thermoplastic and thermosetting resins is stressed.

Rubber as suspension medium with elastic deformation and recovery properties is reviewed by L. E. Hale, who treats of the functional characteristics such as load deflection periodicity and rates. ("S.A.E. Journal," 1946/28.)

Edges of cutting tools are dipped in reusable plastic compound for protection in handling and storage. At Detroit Diesel Engine Division of General Motors Corporation great savings in labour and other operational costs have been achieved. ("Product Engineering," 1946/Nov./55.)

Grinding and polishing, with specified recommendations for different plastics on the market, is subject of illustrated article by C. J. Terpo, of Sales Engineering Dept., Norton Co. Aluminium oxide wheels are recommended for moulded phenolic plastics, but carbide wheels should be used for cast phenolics and thermosetting resins silicon. A reference chart deals with specific recommendations such as cutting-off, form grinding, surface grinding, deburring, buff finishing, ashing and polishing; for the last operations No. 00 pumice mud, tripoli or silica polishing compound are recommended.

Impact strength of plastics has been investigated by Halvard Liander, Cyrell Schaub and Arthur Asplumd, using a drop hammer and an impact hammer; references from English and German literature are quoted. ("Teknisk Tidskrift," 1946/**76**/1011.)

Stress concentrations can be evaluated by means of photo-elastic stress patterns cut out of suitable transparent plastics. Wm. M. Murray, of Massachusetts Institute of Technology, shows some well-chosen examples. The invention of Polaroid has reduced considerably the costs of photo-elastic equipment. ("Product Engineering," 1946/Dec./134.)

Phenomena of impact has been treated from theoretical aspect by L. E. Welch and H. M. Quackenbos. It is indicated

that rupture under dynamic stress-strain conditions results from the same basic considerations as those governing static or flexural failure. (A.S.M.E. Transactions, 1946/**68**/547.)

Failures of acrylic resins used as canopies and turrets, due to crack formations originating at attachment points, are avoided by improved method of edge attachment by means of bevelled strips, as developed by E. H. Snyder for canopy of P-80 aeroplanes, in which aerodynamic and cockpit loads have imposed stresses higher than usual. (A.S.M.E. Transactions, 1946/**68**/767.)

Moulded nylon with unusual bearing strength, heat resistance, toughness, resistance to chemicals offers the designer a useful industrial plastic. Good mouldability and machinability provide interesting applications for many machine elements, such as bearings, small gears, valve seats and electrical parts, according to L. L. Stott. ("Product Engineering," 1946/Dec./103.)

New cast plastic, Textolite 1422, developed by Plastics Division of General Electric Co., has a low power factor with an A.S.T.M. heat distortion of 105 to 113 degrees. It machines well, is adapted to automatic and semi-automatic fabricating equipment, has low specific gravity of 1,045 to 1,050, and still maintains its shape up to 200 degrees C. ("Product Engineering," 1946/Dec./147.)

Short-time tests for plastics as regards exposure to weather, without or with mechanical loads at the same time, do not yield comparable results, according to C. O. Grimm ("Schweizer Archiv f. angew. Wissenschaft and Technik," 1946/Oct./311). The reason appears to be that influence of the weather upon mechanically stressed plastic components leads to a more rapid destruction. At the end of tests all bars showed bending strengths which were above 50 per cent. of initial strength; the bars broke evenly when they stressed to one-fourth of breaking load. The tests described were carried out with phenolic resins incorporating wood flour, organic fibres, chipped textile material, and asbestos as fillers, and further, with carbamide resin and melamine resin. About 24 different component parts were tested, ranging from handles to small gears.

Transparent replicas of bearings are helping Westinghouse engineers design smaller motors with more power. Owing to the transparency of the plastic it is possible to see if seals are working properly, and oil passages are allowing the correct flow of lubricant; relief points are also located. ("Popular Science," 1946/Dec./112.)

MISCELLANEOUS

Pocket-type adhesion tester for plastic coatings has been developed by Bell Telephone Laboratories. The instrument has been found useful for evaluating finishes on parts supplied by sub-contractors. The instrument determines the pressure to be applied to its scratching tool to make it remove the finish and expose the base surface. ("Bell Laboratories Record," 1946/**24**/443.)

Austrian plastics industry is conducting extensive research for the production of new products. ("Chemical Age," 1946/Dec. 21/778.)

Draught losses of boilers are reduced by use of new plastic cement "Industrix," which is capable of sealing both pores and cracks in one operation. The plastic cement does not shrink or fall out when it dries, and it can be applied while the boiler is in operation. ("Machinery Lloyd," 1946/Dec. 21/ 94.)

Movable life-like artificial eyes have been created by Dr. A. Ruedemann, of Cleveland Clinic, using tantalum wires to attach the plastic eye to the four muscles normally serving for movement of natural eye. ("Science Illustrated," 1946/Dec./10.)

New decorating medium in form of luminous walls, murals and pictures pro-

vides both illumination and decoration without the use of conventional lighting fixtures, but making use of special property of transparent plastics to "pipe the light." Possibilities of this new technique, as developed by Röhm and Haas Co., are indicated in acrylic panels with engraved designs, lighted from concealed sources of light at their edges. ("Scientific American," 1946/Dec./268.)

Plastic kits for those who wish to become familiar with the properties of various plastics in common use are being provided by Plastonic Products Co. Experiments can be made regarding bending, casting letters, etc. The working material supplied includes old and new plastics in solid and liquid form. ("Scientific American," 1946/Dec./270.)

Amorphous solid bodies, from viewpoint of their constitution, are reviewed in paper by Prof. E. Brandenberger at fourth Plastics Meeting of the Swiss Associations of Testing Materials, December, 1945. ("Schweiz. Archiv angew. Wissenschaft und Technik," 1946/**12**/338.)

Presses developed by an American plastics concern enables small-scale moulding of casting resins to be carried out at low cost; they are proving advantageous in making plastic tooling, and are particularly useful in moulding phenol-formaldehyde compositions. Moulds can be made from numerous alloys by casting, or from asbestos-filled phenolics; internal coating with good grade of wax facilitates the removal of casts. ("Tooling Engineer," 1946/Dec./28.)

All-plastic folding safety spectacle, known as the "Sto-Away," is being marketed by the Watchemoket Optical Co., Inc., Providence. The design includes a semi-rimless type frame, which is hinged to fold at the bridge. The lenses are made of shatter-proof Impax plastic, which is especially resistant to high velocity impact. ("Product Finishing," 1946/Dec./110.)

Annealing of polystyrene parts requires simple but specific technique. "Scientific American" (1947/**176**/11) deals with the elimination of stress and describes annealing procedures. Controlled-cycle water baths and fixed-temperature ovens are practical if results are checked by the "kerosene" test. According to Plastics Materials Manufacturers' Association, polystyrene is being made at the rate of over 53 million lb. per year. It finds use in synthetic jewels, refrigerators, brushes and cosmetic containers.

Plastic adhesive, which is stronger under bending stresses than metal, has been developed by Baldwin Locomotives Works, Philadelphia. Fatigue tests were made with $\frac{1}{16}$-in. aluminium alloy cemented together. (Machine Tool Blue Book, 1946/Dec./283.)

Plexiglas dome weighing more than 300 lb. and measuring about 11 ft. diameter by $4\frac{1}{2}$ ft. deep, was recently completed by E. L. Cournand Co., New York. ("Machinery" (N.Y.), 1946/**53**/162.) As a single sheet of acrylic plastic 132 ins. square was not commercially available, it was necessary to join several smaller sheets. The cemented joints were buffed and polished to a crystal clarity after cooling. The dome was used for outdoor advertising display of Ford Motor Co.

SOURCES OF REFERENCE.

We wish to remind readers that the sources of reference from which these pages are compiled are not, in general, retained in this office. We cannot, therefore, undertake to supply such originals. Nevertheless, most of the foreign journals referred to are available in the Patent Office Library (Southampton Buildings, Chancery Lane, W.C.2) and in the Science Library (South Kensington). Photo-duplicated copies of articles may be obtained from the Photostat Dept. of the Patent Office.

LETTERS TO THE EDITOR

Correspondents are reminded that a stamped and addressed envelope should be enclosed in all cases where a personal answer is desired.

Pre-heating of P.V.C.

Sir,—I have read, with interest and some surprise, the letter by Mr. D. Warburton-Brown in your January issue (page 20).

Your correspondent claims that R.F. heating of p.v.c. gives more even heating of the material, with complete absence of overheating and discoloration. Experiments which I have carried out have, unfortunately, not substantiated the claim for even heating. For example, 3¾ lb. of p.v.c. material heated for 1¾ minutes in a 5-kw. output radio heater operating at 22 mc/s, gave the following results:—

The starting load was 3 kw., which peaked up to 5 kw. after 40 seconds, and then fell gradually to 2.8 kw. after 1¾ minutes. Temperature measurements by thermojunction at different points in the mass showed variations between 100 degrees and 172 degrees C. The temperature before heating was 20 degrees C. Thus parts of the material had been raised through 80 degrees C. and other parts through 152 degrees C.—nearly 100 per cent. difference!

It is generally recognized that material such as p.v.c., which shows an increase in electrical loss factor with temperature, whilst ideally suited to R.F. seaming or jig welding when in the sheet form, is distinctly awkward to handle satisfactorily when heated in bulk by R.F.

I would be most interested to hear further details in substantiation of the claims for even heating of this material.

Ealing, W.5. E. C. STANLEY.

Linings for Mouldings

Sir,—Can you tell us if cellulose acetate sheet is a suitable material for the lining of plastic salt cellars and mustard pots? L.T.A. AND CO.

London.

[EDITOR'S NOTE.—It is quite well known that some moulded objects are affected chemically and physically by salt and mustard, the former generally containing chlorides that hydrolyse and attack the plastic, and the latter have oils which are by no means non-corrosive. This problem is solved by certain concerns, who use glass liners. Cellulose acetate, we suggest, is not suitable. Polystyrene would be better and polythene probably best.]

Lamp Shades

Sir,—We are anxious to get into touch with makers of plastic lamp shade material, and it would be much appreciated if you could give us the names of one or two firms who are specializing in this particular production.

A. G. KIDSTON AND PARKER, LTD.

Old Jewry, London.

[EDITOR'S NOTE.—The plastics most commonly used are cellulose acetate and polythene. The former is produced with excellent embossed designs if necessary and is made by British Celanese, Ltd., Derby; BX Plastics, Ltd., London; Courtaulds, Coventry; Erinoid, Ltd., Stroud; Utilex, Ltd., Kingston-on-Thames. Crinothene, a new form of polythene, is made by I.C.I., Plastics Division, Welwyn.]

Printing Inks

Sir,—Can you recommend suppliers of printing inks for use on transparent film, and which will dry very quickly?

THORNTON AND ROSS.

Linthwaite, Huddersfield.

[EDITOR'S NOTE.—It depends what plastic sheet is employed; by which we mean that printing, for example, on acetate is different from printing on p.v.c. The latter needs inks made by dissolving p.v.c. or its co-polymers in solvents. The best known ink makers in the country are Coates Bros., London; Winstone, Ltd., London; Mander Printing Inks, Ltd., Wolverhampton; Richardson Printing Ink Co., Ltd., London; E. S. A. Robinson, Bristol; Shuck Maclean, Slough. Manders certainly make a p.v.c. ink and we think Charles Tennant's of Glasgow are also interested.]

Refresher Courses for Designers

Sir,—A year ago the Central Institute of Art and Design was approached by a number of manufacturers who were anxious about the return of their design staff from war service. These men and women, it was felt, had been for some years out of touch with trends of design in this country and might find some difficulty in reorientating their minds.

A series of refresher courses was, therefore, organized for industrial designers, not only to give them opportunities of seeing or reminding themselves of the British tradition, but particularly to study modern trends.

Five of these courses were held during 1946, and proved to be such an unqualified success that the Council of Industrial Design has urged the Central Institute to organize more courses of a similar nature, and these will, like their predecessors, be of three weeks' duration and be held in February, March and April: The courses are, of course, not confined to ex-Service personnel, but are open to any industrial designer, including free-lance designers.

Manufacturers who are interested and think of sending their designers to attend these courses are invited to communicate direct with the Central Institute of Art and Design at the address given.

M. L. ANDERSON,
Deputy Director.

41-42, Dover Street,
London, W.1.

Supports for Electrolytic Work

Sir,—With regard to the correspondence under the above heading, we would like to draw your attention to the application of thick polythene coatings by our flame-spraying process. Polythene is, as you remarked in your editorial notes, probably the ideal material for this purpose; plating racks which we have sprayed have given every satisfaction in service.

SCHORI METALLISING PROCESS, LTD.
Brent Crescent,
North Circular Road, N.W.10.

Moulding Powders from Horn

Sir,—I was interested to notice in your recent editorial (December, 1946) referring to the extraction of keratin from horn and like natural materials, and its subsequent conversion to a moulding powder. I should be glad to learn further details of this process and, if possible, the name of the Czechoslovakian company which has been engaged in production.

CARL E. MORTENSEN.
Copenhagen, Denmark.

P.V.C. Coated Paper

Sir,—We would be glad to contact a manufacturer able to supply a paper base similar to our sample. This appears to be a p.v.c. paper, glazed black. We know that this type of material is being produced in this country.

MOORE AND CO. (LIVERPOOL), LTD.
101-3, Dale Street, Liverpool, 2.

[EDITOR'S NOTE.—The sample certainly seems to be p.v.c. coated. We suggest Leonard Stace, Ltd., Swindon Road, Cheltenham, or Samuel Jones and Co., Ltd., London.]

Plastics Wrapping

Sir,—We are interested in plastics wrapping paper, and wish to know if you can advise us of any supplier.

UNITED WIRE WORKS, LTD.
Granton, Edinburgh.

[EDITOR'S NOTE.—The inquirer does not state if he means transparent sheet or plastic-coated paper. For the former, British Cellophane, Ltd., Bridgwater, Somerset; British Celanese, Ltd., Spondon, Derby; Utilex, Ltd., London. Also see reply to Moore and Co.]

Knobs for Wooden Toys

Sir,—We are manufacturers of wooden toys, and are interested in finding suppliers of plastic knobs measuring about $\frac{3}{8}$-in. diameter. C. W. NORRIS, LTD.
Farnworth, Near Bolton, Lancs.

S.A. Brush Co., Australia

The Editor wishes to express his gratitude to the directors of the S.A. Brush Co., of Flinders Street, Adelaide, for their thoughtfulness and very welcome gesture.

Solventless Varnishes for Electrical Insulation

By H. W. CHATFIELD,
Ph.D., F.R.I.C., A.M.I.Chem.E.

SOLVENTLESS varnishes represent the merging of varnish-like products into the realm of true plastics. The term "solventless varnish" can be regarded, most times it is used, as being synonymous with the term, "plastic." When solventless varnishes are correctly and specifically designed for the impregnation of electrical equipment, they can be described as plastic impregnants without any reservation whatsoever. This is because they are essentially synthetic in character, and cannot be formulated successfully from simple mixtures of drying oils and natural resins. Plastics are generally free of solvent, except for accidental traces, and in this respect solventless varnishes fit in with this commonly accepted characteristic of plastics. Like plastics, solventless varnishes need not contain any volatile matter.

In the discussion which follows, solventless varnishes are the types used for the impregnation of electrical equipment. There are other types of insulating varnish, but these are purposely omitted from the present discussion.

"Why solventless varnish?" This is a natural question which is best answered by considering, first, the functions of solvents in varnishes, and secondly, the disadvantages which are attendant upon their presence.

The Function of the Solvents

Solvents in varnishes perform several important functions.

(i) They make it possible for the varnish to be applied to a given object. If solvents were absent the viscosity of the non-volatile portion of the varnish would be too high either for pouring or application at ordinary air temperature.

(ii) Solvents are commonly employed to reduce the viscosity of varnishes to low levels to assist penetration into fine windings, for obviously, other factors being equal, a lower viscosity must assist the movement of a liquid. Moreover, carefully chosen solvents, with suitable surface tensions, as evidenced by good wetting properties, also assist penetration of varnish. A varnish with an initially low viscosity is not always necessary for satisfactory impregnation. There are few instances, if any, where a correctly constructed varnish of high viscosity, handled skilfully, cannot be effectively introduced into the finest of windings.

(iii) The presence of a solvent in a varnish permits the polymerization of the non-volatile constituents to be taken to a high state during manufacture. Thus it follows that less processing time at high temperature, after application, is required to convert the varnish to the irreversible gel expected. The degree of polymerization effected during the manufacture of the varnish is limited by the stability of the final product during storage, and by the reduction in the volume of the non-volatile constituents which is acceptable.

(iv) Solvents in varnishes, especially varnishes of the highly polymeric types, tend to confer a stability on the product by their diluting effect. Some solvents, consisting of blends of several organic liquids, have powerful "cutting" effects on viscosity. There is, however, a limit to the extent to which reliance can be placed on the power of such blends to confer stability for long periods of time.

The functions and advantages of solvents in varnishes have been fairly enumerated, but they possess, unfortunately, many notable disadvantages.

It will now be shown that the disadvantages of solvents greatly outweigh their advantages, and that the introduction of solventless varnishes is the next logical step for the impregnation of electrical equipment.

Cost Considerations

(1) First, the use of a solvent is economically unsound. It may constitute as much as 50 per cent. of the total volume of the varnish, and during the drying process this is lost by evaporation —at least it should be for satisfactory results. The volatile portion of the varnish has no permanent value as an insulator; literally, it disappears into thin air!

The loss of solvent from a varnish is, in most cases, complete, and it is only on very rare occasions that a plant is encountered with an efficient solvent condensing or absorption system. Furthermore, the installation of such an arrangement represents a large additional cost to an already costly vacuum-pressure impregnation plant.

In assessing the cost of a solventless varnish, and comparing it with that of a solvent-containing varnish, it must be noted that the latter contains a substantial amount of material which has no permanent value at all. If, for example, the solvent-containing varnish has a volatile content of 40 per cent., and costs 30s. per gallon, the cost of the useful non-volatile portion is 30s. for 0.6 gallon, or 50s. per gallon. To this figure must be added the cost of extra thinner, added to replace that lost from the varnish by evaporation during application, and also the extra cost of labour involved in incorporating it.

Cost figures, based on prices per gallon of the two types of varnishes as supplied by the manufacturer, are misleading, for generally the solvent-containing varnish will erroneously appear much cheaper. This position can easily arise because the solvent-containing varnish comprises a substantial proportion of solvent, which happens to be the cheapest constituent of the varnish.

In actual fact, by logical reckoning, the reverse is more often the case, and the solventless varnish is much the cheaper proposition.

Objectionable Odours

(2) It is usually the solvent which gives a varnish its characteristic smell. This may be pleasant or unpleasant, and only too frequently forms the source of serious complaint by operatives—especially if females.

Solventless varnishes can be made free, or practically free, of any objectionable odour at room temperature, by reason of their very low and almost negligible vapour pressures. This means that dipping or draining operations, where large areas of varnish are exposed, do not cause the loss of volatile solvent and cannot form the subject of complaint.

Varnishes containing solvent are usually so formulated that the solvent chosen is a type with a very high vapour pressure—the object being to facilitate its removal during any subsequent drying process. As a consequence the solvent has every opportunity to evaporate during application of the varnish, and to yield objectionable atmospheres. With solvent-containing varnishes it may be necessary to augment the natural ventilation of the workroom by artificial means, and this entails additional expenses.

Some so-called solventless varnishes may be based on monomeric constituents, or mixtures of these with dimeric constituents. Gelation of these varnishes inside components is effected either by the presence of a catalyst, by heating, or by a combination of both. With such forms of varnishes, which, because of the presence of monomeric constituents, cannot be truly classified as solventless (as such constituents are really solvents), some odour from these unpolymerized portions may be apparent at ordinary temperatures. The odour emanating from varnishes during storing is likely to be more pronounced than at room temperature, and this is very true of solvent-containing varnishes, and the

so-called solventless varnishes based on monomeric compounds.

With solventless varnishes of ideal composition, elevation to the storing temperature has no marked effect in stimulating odour.

Toxicity of Solvent Vapours

(3) There is not only the smell of the varnish to consider, but the toxicity of the vapours responsible for it. This can, of course, be reduced to a minimum with good general ventilation, but the danger, nevertheless, still exists. Moreover, it is reduced only by the expenditure of some capital.

The toxicity effects of varnishes are due to both volatile and non-volatile constituents, but the latter are not responsible for narcotic or irritant effects on the lungs, nor need they cause conjunctivitis or inflammation of the eyes. Toxæmic conditions can also occur through contact with the skin of operatives' hands, and both volatile and non-volatile constituents may stimulate these. Generally, however, as might be expected, the greater solvent action of the volatile constituents causes the most trouble. With solvent-containing varnishes, therefore, the chances of an operative being affected physiologically are at least doubled, for both volatile and non-volatile constituents may be effective.

Viscosity Troubles

(4) Ordinary varnishes entail more work than the solventless types. This is chiefly on account of viscosity changes, subsequent to delivery of the varnish.

Since, often by choice, the solvents used in the ordinary varnishes are extremely volatile, large amounts of solvent may be lost by evaporation. There are several sections of the impregnating process where loss of solvent occurs. These can be enumerated as follows:—

(a) DURING STORAGE. Volatile solvents disappear through imperfectly sealed containers, and it is not such an easy matter to obtain a perfectly sealed container as might be supposed. Containers for solvents which would have to be used for thinning purposes are particularly susceptible to develop losses by evaporation.

(b) DURING IMPREGNATION UNDER VACUUM. The loss of solvent occurring here is likely to be of a high order. The precise magnitude of the loss will depend upon the duration of applying the vacuum to the varnish. In any case the reduced pressure will naturally cause a much greater evaporation rate.

Ordinarily, cold varnish is sucked into an evacuated autoclave, where it meets the previously heated components. The heat content of these components is transmitted to the varnish fairly rapidly by conduction, and the increase of temperature of the varnish means that the solvent is released at a correspondingly greater rate. In practice the varnish loses solvent so long as there is any left in it, if the vacuum is applied continuously.

(c) DURING DRAINING. After impregnation as much of the surplus varnish as possible is drained from the components before passing them into the store. This process occupies upwards of half an hour, so for this time the solvent has a good opportunity to evaporate from the surface of the still warm component, from the streams of warm varnish draining from it, and from the exposed surface of the varnish in the draining tank.

The viscosity of solvent-containing varnishes must, therefore, increase during use, possibly so much that they can become unusable unless readjusted. Time and labour must be expended in making these adjustments. A certain degree of technical control is also needed to ensure that the thinning process is satisfactorily carried out, and that excessive thinning does not occur. A responsible person must also be deputed to decide when the varnish requires thinning. Someone more than a casual labourer is essential for this work.

Fire and Explosion Hazards

(5) The dangers of fire and explosion are very real hazards with ordinary varnishes containing solvent. With solvent-

less varnishes they are either non-existent or present only to a negligible extent.

It has been explained already that when solvents are incorporated they are selected often for their high volatility, to facilitate their subsequent removal. In varnishes, high volatility necessarily means a high vapour pressure, and greater inflammability. Non-inflammable solvents are precluded from varnishes for other very strong reasons.

The volatile solvents commonly employed flash at room temperature or slightly above. The solvent with the highest flash-point, which technologists would still regard as a practical proposition for a varnish, is white spirit. Common grades of white spirit have flash-points within the range of 90-95 degrees F. (Abel), and the varnish is considerably above this range in at least two stages of the process of component impregnation. These higher temperatures are attained in the autoclave, or in the open container holding the varnish, as the result of the heat transmitted from the preheated components, and in the drying oven.

There is thus a danger of fire or explosion with ordinary varnishes, and very special precautions must be taken if these troubles are to be avoided. The real danger with solvent-containing varnishes is a violent explosion in the autoclave, and fatal accidents have been recorded. The precise courses of such accidents are somewhat intangible, but it is easy to see how explosive conditions can arise.

It is a common and very useful practice to subject both components and varnish in the autoclave, first to vacuum and then to pressure. In the second stage, when the vacuum is released, a pressure is gradually applied, vapours of volatile solvents will be present in the space over the varnish. It is most unlikely that all the volatile matter will have been removed from the varnish. These vapours are then subjected to a high pressure in the presence of oxygen from the air. That is to say that the conditions are just right for an explosion of considerable violence.

Just how detonation has occurred in practice is still a matter of conjecture, and it is unwise to dogmatize. The fact remains, however, that fatal explosions have occurred and have been the subject of inquiry, and it has been realized that the conditions provided are the worst possible. Some plants have facilities for administering nitrogen to the autoclave before pressure is applied, in order to nullify the explosive conditions prevailing.

With solventless varnishes of the correct design, no such danger of explosion exists at any stage of the impregnating process.

Possible Attack of Enamel

(6) One of the greatest drawbacks of solvent-containing varnishes is their tendency to attack the enamel of enamelled wire. The enamel on copper wire is usually of two distinct types: the one is essentially an oleo-resinous product, and the other synthetic in character, often quite devoid of vegetable drying oil. Both types are dried on the wire by stoving at a high temperature for a short time.

It is common knowledge that stoved oleo-resinous films do not possess complete resistance to solvents. In use, considerable trouble has been encountered as the result of electrical breakdown of impregnated equipment, through the disintegration of the enamel of the wire by solvents in the varnish. This trouble is a feature of the recent advances made in the formulation of improved impregnating varnishes of synthetic character. The synthetic resins used require stronger solvent combinations to provide compatibility and to maintain stability. These strong solvent combinations have a much greater tendency to attack wire enamels of the oleo-resinous types.

The possibility of attacking enamel by solvents in the impregnating varnish is not peculiar to enamels based on drying oil-resin combinations, for some kinds of

the purely synthetic enamels are attacked by certain varnish solvents.

So-called solventless varnishes containing substantial amounts of monomeric constituents, already referred to, may also attack wire enamel if such constituents are good solvents.

The non-volatile constituents of a varnish do not, in general, tend to attack wire enamel. It is possible, therefore, to prepare solventless varnishes which do not possess dangerous solvent properties, even at the elevated temperatures used for stoving, and which may be used safely with all good grades of enamelled wire, whether the enamel is oleo-resinous or synthetic.

Void-filling Medium

(7) An impregnating varnish is chosen primarily because it is hoped it will fill the voids between the windings and elsewhere in electrical equipment.

Any imperfections in the original insulation of the wire are sealed, undue movement is prevented between windings, ingress of moisture leading to electrolytic corrosion is prevented, good heat conduction is provided, and dissociation of occluded gases or vapours as the result of high-voltage influences causing serious chemical degradation is eliminated. There are, therefore, very good reasons to aim at perfect impregnation.

Is it possible, however, to attain this ideal state with a solvent-containing varnish? To this question the answer is "No," except possibly in a few special cases, or unless an extremely laborious process of impregnation is instituted.

After drying the equipment to be impregnated, at a convenient temperature, and subjecting it to a vacuum to remove the last traces of moisture and all occluded air, it is submerged in varnish. If the air removal has been thoroughly effected, varnish can take its place and completely impregnate the component. If the varnish has difficulty in finding its way into the minute spaces between the windings, or through paper interleaves, its passage can be facilitated by the application of pressure.

Now let us assume that by these means perfect impregnation has been achieved with a varnish containing solvent. All voids will be filled, not with a permanent non-volatile material, but with a mixture of both volatile and non-volatile components. The former component, having performed its role of viscosity-modifier, has to be removed, and it is at this stage that several difficulties are encountered.

If the solvent is evaporated either by application of vacuum or heat, or by a combination of both, there is no guarantee that the space left by the solvent will be refilled by the non-volatile constituent of the varnish. The space left by the solvent may be 40 per cent. or more of the original volume of the varnish absorbed.

In equipment employing heavy gauge wire, recession of non-volatile varnish to take the place of solvent is possible, but by no means definite. Where very fine wire is used it is most unlikely that such a process can occur, and in most cases it is not possible to remove the solvent. Thus there is the probability either of voids being left in the components or solvent being locked in permanently.

Solvent evaporates easiest from the outside of an impregnated component, and it becomes increasingly more difficult for the solvent at the core to diffuse to the surrounding air. This is for two reasons. First, the nearer the centre of the component the greater the thickness of liquid varnish through which the solvent must diffuse, which naturally retards the overall rate of evaporation. Secondly, the rate of evaporation is further retarded because the varnish near the surface of the coil will have lost most of its solvent and will have become very viscous.

Since most varnishes oxidize to some extent, it is not unlikely that a solid dried film will be formed at the outside of the coil, and this will effectively detain any residual solvent. Furthermore, it is not necessary for the varnish to be oxidizable for this external film formation to occur. It can take place quite easily with truly thermosetting varnishes. Attempts are made to prevent these defects by employ-

ing solvent removal under vacuum, and by subjecting the component to a very carefully controlled and gradually rising temperature. The process is, nevertheless, very tedious, and one which does not commend itself to users who aim at high output figures.

During the impregnating process in the autoclave, the warm evacuated components are submerged in varnish, sucked in by the prevailing vacuum. With an ordinary varnish the first stage in the process is that the volatile solvent is preferentially withdrawn from the incoming varnish. This removal of volatile solvent from the varnish continues so long as the varnish is maintained under vacuum. If a very efficient vacuum pump is not used, the pressure in the autoclave will increase as the result of sudden and continuous evolution of volatile matter from the varnish, and the voids in the evacuated component, from which air was carefully removed previously, will be filled, at least in part, with solvent vapour. This vapour, just preceding the liquid varnish, will form an elastic cushion in the windings, and hinder perfect penetration of the varnish. With a solventless varnish this cannot happen and the varnish fills the voids as completely as the initial vacuum allows.

Polymerized Components

Solvent-containing varnishes are often mixtures of highly polymerized components, dispersed in a solvent. This is one of the reasons for the presence of the solvent, for the non-volatile portion would be too viscous to manipulate otherwise. Such heterogeneous products may cause considerable trouble during impregnation, especially with components involving very fine wire and paper interleaves. The construction of such equipment may cause the system to act as a filtering medium.

The highly polymerized components will be retained by the filtering medium, and the penetration obtained under vacuum may be of a very low order. Application of pressure later will tend to force the monomeric solvents through the filtering medium, selectively, and an imperfectly impregnated component will be obtained, comprising solvent inside—precisely where it is not required—and an outer jacket of varnish.

In the case of an ideal solventless varnish such physical separation of solvent and non-volatile component is impossible. Less highly polymerized components may, of course, be permitted through the filtering medium, but these possess the same chemical make-up as the bulk of the varnish and can be polymerized effectively by subsequent heating.

Types of Solventless Varnish

From the foregoing analysis of the respective properties of the ordinary solvent-containing varnishes and those of the recently developed solventless products, it will be realized that the latter possess many advantages over the former.

The formulation of solventless varnishes has been attempted in several different ways, and not all products are without their defects. Some are based on substantially monomeric constituents, which are treated with a polymerizing catalyst just before dispatch to the consumer, or by him immediately prior to use. First, it is something of a misnomer to describe such products as solventless, for in the early stages of polymerization considerable monomer is present and this is likely to be partly volatile at the stoving temperature.

Secondly, the presence of the catalyst is to ensure that polymerization occurs in a reasonable period of time; unfortunately, many of such products, which might be suitable otherwise, cannot be used on the large scale in practice, because of poor storage stability. If they are warmed above air temperature during application, the process of gelation is assisted forward, and the consumer cannot risk gelling his complete supply of varnish in his storage tank. Often these tanks are badly sited in many impregnation plants, being underground and virtually inaccessible.

Moreover, if the consumer is expected to make blends of catalyst and varnish,

or of two separate components of the varnish, just before use, he regards this, quite rightly, as irksome, and there is, of course, the chance that the addition of catalyst might be accidentally overdone.

When a catalyst must be added, it should be non-corrosive, neutral, and non-explosive. Possible catalysts are sometimes acidic, as in the case of those based on mineral acids, acid salts, or organic compounds which generate acidic products by hydrolysis. These may stimulate corrosion inside the component.

Considerable research has been conducted on solventless varnishes which do not suffer from any of the above defects. These new developments are self-catalysed, in other words they are ready for use by the consumer, without the necessity of any addition, whatsoever. The catalysts selected are neutral and are absolutely safe. Excellent storage life is provided because the polymerization reaction is designed to occur at a specified range of stoving temperature. The rate of polymerization, at temperatures such as those likely to be present during impregnation, is negligible, and the storage life can be regarded as unlimited.

As in the past, the old form of oleo-resinous impregnating varnish with imperceptible polymerizing properties gave place to oil-base varnishes of similar type with polymerizing properties; and these in their turn have been gradually superseded by true synthetic thermo-setting varnishes, so now we are witnessing the gradual but certain replacement of these by the much superior solventless polymerizing varnish.

The substance of this article is based on the results of research conducted for Jenson and Nicholson, Ltd., whose permission for publication is gratefully acknowledged.

The Designer Adopts Plastics

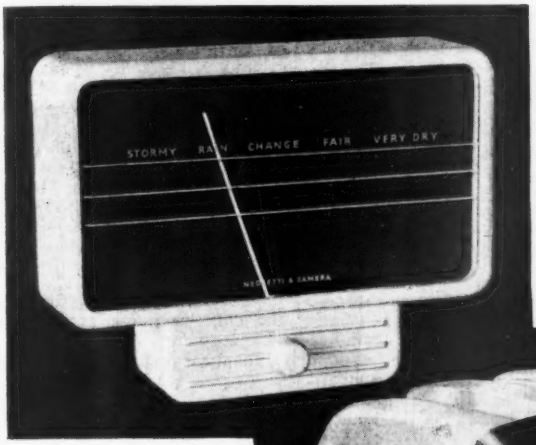
OUR illustrations opposite show three examples of design applied to household goods incorporating plastics as the main constructional feature.

The barometer, which has been designed by Richard Lonsdale-Hands, is to be put into production for Negretti and Zambra. The overall casing is of urea-formaldehyde. Prominence has been given to direct reading of indicated weather, but for those who wish to calculate the precise degree of barometric pressure there is provided a table of figures, with an adjustable pointer to gauge variations of temperature from day to day. The indicator arm is attached to the recording mechanism in exactly the same manner as for any normal barometer. This is an interesting point, as the design incorporates the usual mechanism of the modern aneroid barometer.

The toaster is the work of The Design Group, Ltd., for British Diamix, Ltd. Bread may be toasted to four degrees of crispness by a simple movement of the dial, which is clockwork operated to preset the time interval after which a spring is released to automatically eject the toast. The dial in no way controls the heating element, which once switched on continues to remain hot. Capacity is limited to two slices of toast simultaneously. Moulded in phenol-formaldehyde, partly of maroon colour, with a chromium-plated dial, this almost cubic design appears to be well proportioned and adequately stable to allow the rotation of the dial without fear of overturning the toaster.

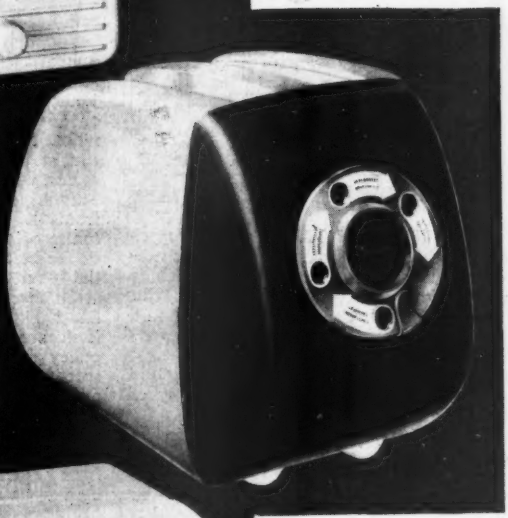
The radio receiver for A. C. Cossor, Ltd., another design by Richard Lonsdale-Hands, has actually been purchased by the Council of Industrial Design as an outstanding example of contemporary styling in industry. This receiver is moulded in urea-formaldehyde of cream colour. One of its features is the increased angle of the wavelength dial for easy visibility; the actual dial is protected by transparent plastic.

The Designer Adopts Plastics



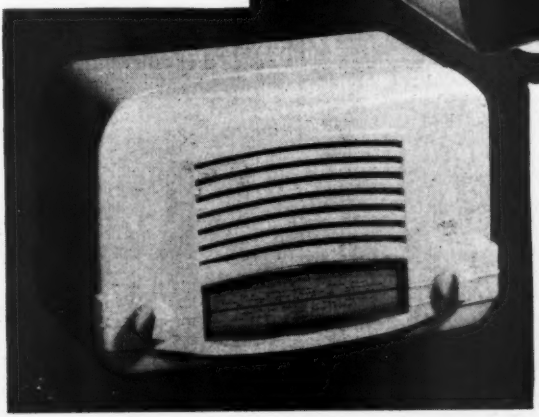
New conception of a barometer, designed by Richard Lonsdale-Hands for Negretti and Zambra, the casing moulded in urea-formaldehyde resin.

Simplicity of outline accentuates clear indication of weather forecast.



Toaster, of phenol-formaldehyde resin, with chromium dial, the work of The Design Group, Ltd., for British Diamix, Ltd.

The approximately cube-like form suggests stability.

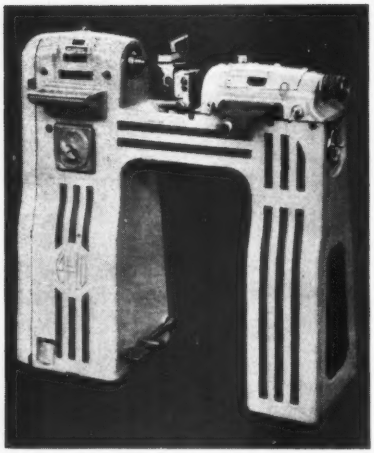


Radio receiver, of urea-formaldehyde, with transparent plastic cover for dial, designed by Richard Lonsdale-Hands for A.C. Cossor, Ltd.

Pleasantly styled to harmonize with varied surroundings.

PRODUCTION NEWS

Raw Materials, New Plant, Works Organization, Control Apparatus, Research, Personal and Trade Notes



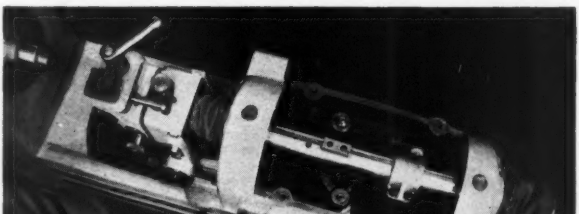
A NEW HAND LATHE, designed especially for the rapid turning of plastics, is now in production by E. H. Jones (Machine Tools), Ltd., of Edgware Road, The Hyde, London. This "Anglon" lathe is built in a sturdy fashion, and possesses several interesting features; for instance, it is of a height which enables the operator to sit at the job in comfort, and a tray for a ready supply of blanks is provided.

The bed of the machine has tapered sides internally, and a chute which opens to the back to allow the finish-turned articles to pass into boxes. If the articles be buttons or something of similar size, the bed will hold a considerable quantity with the chute closed. All covers, with the exception of the door at the rear, are firmly screwed down to prevent ingress of dust, and provided periodic lubrication is carried out, there is no necessity for these covers to be removed.

A light but sturdy spindle is mounted in robust, high-speed anti-friction ball bearings. The collet mechanism, contained in the spindle-head, is actuated by a heel-operated pedal, which has a "rest" fitted for the ball of the foot. The collets are operated on the "dead-length" principle, by a moving outer sleeve available in four sizes up to 120 lines capacity. Collet drawbar, and adjusting knob for the collet-operating spring, are easily accessible at the rear of the spindle.

The drive to the spindle is through a standard V-belt, from a 1 h.p. motor. Two ranges of three speeds are obtainable: 930, 1,400, 1,870 r.p.m. with a 1,400 r.p.m. motor, or 1,900, 2,700, 3,750 r.p.m. with a 2,800 r.p.m. motor. The speed-changing device consists of a three-step V-pulley on the motor, with a single-step V-pulley at the top. This arrangement keeps down the distance from the top of the spindle-head to the centre of the spindle, enabling easy placing of the blanks in the collet, and the load of the V-belt drive is kept close to the bearings at all speeds. Change of speed is simple; a knurled knob at the end of the motor spindle is slacked off, and a disc at the back of the pulley turned 90 degrees. This gives two speeds; the third speed is obtained by removing the knurled knob, sliding off the pulley, reversing and locking up again with the knurled knob.

The motor is mounted on a pivoted platform which can be locked in any position by a single nut on the outside of the cabinet.



The "Anglon" lathe: details of tool-feed mechanism.

This also constitutes a tensioning device for the driving belt.

The tailstock is operated on the circular ram principle; it can also be moved along the bed on dovetail slides, which are provided with a gib for adjustment. A screw feed is obtained by means of a small hand-wheel, and there are locking handles for clamping the tailstock in any position along the bed.

The patented tool-feed mechanism, which is shown in one of the accompanying illustrations, prevents the operator slamming the tool into the work. This mechanism gives an extremely fine speed, and has rapid deceleration as it approaches the end of the stroke; there is also an equally rapid acceleration on the withdrawal. The mechanism, moreover, is provided with a "dead stop." The tool platform is inclined at 5 degrees to the horizontal, which is the recommended angle for tungsten carbide-tipped tools. A slot, through which protrudes the collar of a knurled adjusting screw, provides a fine forward adjustment for a depth of cut. Tool shanks up to a maximum of 1½ in. (2-120 lines) can be accommodated. "Steadies" on the sides of the tool slide are fitted with large-diameter rollers; these are shrouded and carry felt wipers to clean the tracks.

BRITISH INDUSTRIAL PLASTICS, LTD.—There has been no slackening of demand for the moulding powders and other materials manufactured by British Industrial Plastics, Ltd. The accounts for the year ending September 30 last show that gross profits amount to £391,146, compared with £280,681 for the previous year. Net profits are about £21,000 higher at £44,512. The directors recommend a distribution of 12 per cent., which compares with 8 per cent. paid for each of the four preceding years, leaving £15,959 to be carried forward. The new capital raised July last ranks for full dividend.

O. AND M. KLEEMANN, LTD.—The first annual general meeting since conversion into a public company in June last, was held on December 18, Mr. O. Kleemann, chairman of the company, presiding. Net profit for the year is £265,061 compared with £110,154 for the previous year; deducting £157,919 in respect of Excess Profits Tax, the balance of £107,142 (compared with £47,809 for last year), adding £16,116 brought forward from last year, makes £123,258 available. The directors recommend payment of a final dividend of 50 per cent., less income tax, bringing total dividend for the year to 80 per cent. The amount carried forward is £29,291.

At the time O. and M. Kleemann, Ltd., was converted into a public company, new factories had been acquired at Aycliffe; production began in November, 1945, and in June it was still on a comparatively limited scale. Since that time production has considerably increased, but has not yet reached its full capacity. Two more factories at Welwyn Garden City have been rented to deal with the manufacture of cellulose acetate moulding powder. Adequate supplies of raw material are available for present requirements. Sales for the first three months of the current year are considerably in excess of the corresponding period of the past year. The larger proportion of the company's sales is still in the overseas market.

THOMAS DE LA RUE AND CO., LTD., have made application for Treasury consent to issue preference and ordinary shares to the respective classes of shareholders. Proposed alterations to the capital structure include the conversion of the existing 347,000 issued ordinary £1 shares into stock transferable in 5s. units. Of the unissued capital of £665,016, the directors intend designating £500,000 as 3½ per cent. cumulative preference £1 shares, and £116,000 as ordinary £1 shares, leaving £49,016 unclassified. The preference shares and additional ordinary shares will also be converted into stock.

MOULDED PRODUCTS, LTD.—Changes are announced in the board of this company, which is to be merged with De La Rue Plastics, Ltd., to form the new National Plastics Company. Messrs. W. J. Merifield, C. G. Peel and N. Einstein have resigned; Mr. R. E. N. d'Abo has been elected chairman, and Mr. H. E. Hill has been appointed a director of the company.

CRYSTALATE, LTD., held their annual general meeting in London on December 18, Sir Herbert E. Morgan, chairman of the company, presiding. Net profit for the year, after taxation, amounts to £13,251, compared with £13,059 last year. A dividend of 6 per cent., less tax, was declared.

A. BOAKE ROBERTS AND CO., LTD., regret to announce the death of Mr. W. F. Blair, of their sales staff. The late Mr. Blair had been in the service of the company since 1926 and travelled extensively, particularly in the Far East. Since 1938 he represented the company in Scotland.

NATIONAL PLASTICS, LTD.—The registration is announced of National Plastics, Ltd., which is to acquire and amalgamate the undertakings of De La Rue Plastics, Ltd., and Moulded Products, Ltd. The initial nominal capital is £100 in £1 shares. It is understood that the new company will not be the subject of a public flotation, nor will there be any public issue in the near future.

LACTIC CASEIN PRICES.—The Director of Sundry Materials, Board of Trade, announces that, as from January 1, 1947, the selling prices of lactic casein, distributed through the agency of the Lactic Casein Importers' Association, Ltd., 23, St. Swithin's Lane, London, E.C.4, will be as follows:—

	One ton and over.	Under one ton
90 mesh	£240	£245
60 mesh	£235	£240
30 mesh	£235	£240
Soluble	£245	£250

For quantities of under one bag the price is 5s. 3d. per kilo. All prices are net ex warehouse.

BX PLASTICS, LTD., has put into production the first section of their 50,000 sq. ft. plant on the industrial estate at Dundee, despite the fact that less than half of the machinery required has been delivered.

TUFNOL, LTD., are now working a five-day week. Henceforward, no goods will be received or despatched on Saturdays or Sundays.

GANSOLITE, LTD.—Mr. A. van Santen has been elected as an additional director. He has been connected with the company for more than 15 years; for several years he has filled the position of sales manager, which he will continue to do.

BRITISH INSULATED CALLENDER'S CABLES, LTD.—Mr. W. G. Hendrey and Mr. W. H. McFadzean, directors, have left England on a visit to the company's branches in India. They are expected to be away for several months.

TRIPLEX SAFETY GLASS CO., LTD., announce that Mr. V. Ashton has been appointed works manager of the Perspex Department at the Willesden factory. Mr. Ashton joined the company at the end of 1946, having previously been with a Cardiff engineering firm. Prior to that he held a post with the Ford Motor Co., Ltd., at Dagenham. Mr. C. L. Cripps, who has been with Triplex Safety Glass Co., Ltd., since 1928 and was formerly at the King's Norton (Birmingham) factory, has been appointed works manager, Safety Glass Department, at the company's Willesden factory. Until 1938 Mr. Cripps was concerned with the production of safety glass, but subsequently was in charge of the Plastic Department at King's Norton.

WILD-BARFIELD ELECTRIC FURNACES, LTD., announce that the address of the Birmingham Office and Service Depot of the company is now 21, Steelhouse Lane, Birmingham, 4. (Telephone: Central 6372.)

MR. E. S. WADDINGTON, of Philips Industrial (Philips Lamps, Ltd.), has been elected a vice-president of the Society of Engineers, which is the third oldest professional engineering society in Great Britain.

DR. CHARLES ALLEN THOMAS, vice-president and technical director of Monsanto Chemical Co., the American associates of Monsanto Chemicals, Ltd., has been elected president of the American Chemical Society.

INDUSTRIAL PUBLICITY.—James White (Industrial Artists), Ltd., have opened a head office at Grand Buildings, Trafalgar Square, London, W.C.2 (Whitehall 2421). The Design Section will continue to operate from 42, Ludgate Hill, London, E.C.4, under the direction of Mr. James White.

CATALIN, LTD.—Mr. G. K. Franklin has returned to this company, after release from the War Office, and has been appointed export sales manager.

E. K. COLE, LTD.—A new factory with potential employment for nearly 1,000 persons is to be built at Rutherglen, Lanarkshire, by E. K. Cole, Ltd., for the manufacture of domestic and car radio, fluorescent lighting fittings, and control gear. Since 1944 the company has been using a Government factory at Rutherglen placed at their disposal during the war, when they produced radio and radar equipment to the value of £17 million. That factory is now too small to handle post-war requirements.

DE LA RUE PLASTICS, LTD.—Mr. W. S. Hindle has been appointed secretary of this company, his appointment taking effect as from January 1, 1947.

Manufactured by :

THE MICANITE & INSULATORS CO. LTD.

Empire Works, Blackhorse Lane, Walthamstow, London, E.17

Manufacturers of MICANITE (Built-up Mica Insulation). Fabricated and Processed MICA; PAXOLIN (Synthetic-resin laminated sheets, rods, tubes and cylinders). HIGH-VOLTAGE BUSHINGS and TERMINALS for indoor and outdoor use. EMPIRE varnished Insulating Cloths and Tapes and all other forms of Electrical Insulation. Suppliers of Vulcanised Fibre, Leatheroid, Presspahn, etc. Distributors of Micoflex-Duratube Sleevings and Kenutuf Injection Mouldings (P.V.C.).

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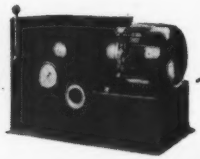
Sustained Pressure

without RELIEF VALVE

CUT-OUT VALVE or ACCUMULATOR

THE *Motorised* PUMP UNIT

This Unit is suitable for converting hydraulic presses from the central system to independent operation, or may be used for operating a range of small hydraulic presses. It is a completely self-contained hydraulic system in which is mounted the Turner A.V.D. Pump directly coupled to a totally enclosed surface-cooled electric motor running at 1,500 r.p.m. Full details sent on request.



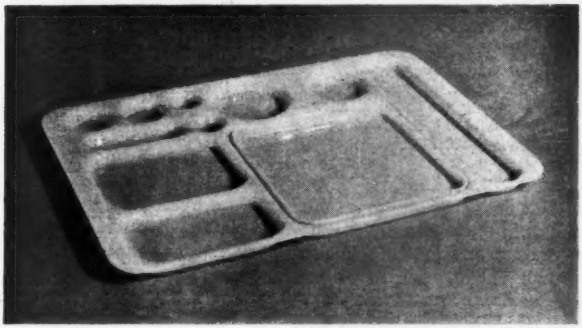
NEW PUMP DEVELOPMENT GIVES GREATER VERSATILITY TO PLASTICS MOULDING PRESSES

Turner Automatic Variable Delivery Pumps have been designed for compression and injection moulding machines, and for other applications requiring simple and reliable control of variation in volume and pressure. The idling pressure of the model illustrated above is easily adjusted from 500 p.s.i. to 2,500 p.s.i. and once the predetermined maximum is reached the pump automatically moves to a no-stroke position, maintaining the pressure without relief valve, cut-out valve or accumulator. Three types of Turner Hydraulic Pumps are available :—Automatic Variable Delivery, Variable Delivery and Fixed Delivery. Literature describing the complete range will gladly be sent on request.

TURNER HYDRAULIC PUMPS

TURNER MANUFACTURING CO., LTD., WULFRUNA WORKS, VILLIERS STREET, WOLVERHAMPTON

New Productions from the Moulding Shops

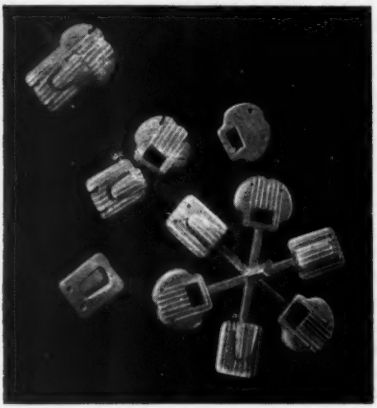


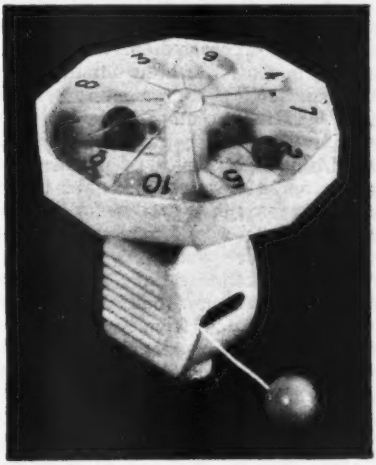
Tray for Airways' Use

B.O.A.C. have produced this tray for their catering department. It is used on board aircraft when supplying meals to travellers. It is strong, light in weight and hygienic in appearance, and, in fact, extremely easy to clean. Formed and pressed out of " Perspex " by the Experimental Factory of B.O.A.C. at Brislington, Bristol.

" Uni " Hook Fasteners

New design in cellulose acetate fasteners is injection moulded by Plastic Fasteners, Ltd., associate company of Ornia, Ltd. (see next column). Strong and well made, with overall length of 1¼ ins.





New Novelty Toy

This amusing little toy, called " Jokitot," is marketed by Ornia, Ltd., of 50, Station Road, Willesden, London, and would seem to be a method of teaching children the mysteries of arithmetic, of deciding who shall pay for drinks, or of carrying on a little flutter in straight roulette or dog-racing. It is cleverly designed and sturdily made, and is built up of seven injection mouldings in cellulose acetate and a pressed polystyrene disc. Moulded for Ornia, Ltd., by Jason Plastics, Ltd., Westmont Road, Esher, Surrey.

Halogenated Polythenes (Contd.)

By E. E. HALLS

In this second instalment, the author deals with further patents covering the polymerization of tetrafluorethylene, and then proceeds to deal with the polymerization of dichloroethylene.

BRITISH Patent No. 574,688 (1945) of E. I. Du Pont de Nemours covers the polymerization of tetrafluorethylene at elevated temperature and pressure in the presence of water and oxygen, ozone or an organic peroxide. The temperature range claimed is 55 to 240 degrees C., and pressures above 500 lb./sq. in. A water soluble base to render the water alkaline is also covered. The quantity of oxygen in contact with the tetrafluorethylene covered by this patent is between 0.03 and 0.3 per cent. of its weight. The objective, as with the previous patent, is to obtain a higher yield of polymer and more rapid polymerization. The use of molecular oxygen as catalyst for the process is particularly attractive from the commercial viewpoint.

The specification states that the polymerization reaction can be brought about at any temperature from room temperature to about 250 degrees C. The highest yields are obtained between 55 and 240 degrees C., and particularly between 75 and 160 degrees C. The pressure may be as low as 500 lb./sq. in.; the most satisfactory pressure that can be employed (e.g., 1,000 atm. or above) is limited only by the mechanical difficulties involved. The pressures quoted in the patent refer to the partial pressures of the monomeric tetrafluorethylene, because additional pressure may be secured by means of an inert gas, such as hydrogen, carbon dioxide and nitrogen. The pressure obtained by means of the inert gas is not a critical factor in operability.

The amount of water present during the reaction, expressed as a ratio of the weight of tetrafluorethylene, may be as low as 1/20 or as high as 20/1. The preferable ratio is 1/2. It is preferable that the water be rendered alkaline by dissolving a water soluble base in it; for example, alkaline metal hydroxides, carbonates or bicarbonates, or alkaline earth hydroxides. Caustic soda, caustic potash, barium hydroxide, hydrated lime, sodium carbonate, potassium carbonate, lithium carbonate, ammonium hydroxide and ammonium carbonate are cited as examples. Again, water soluble salts of the alkali metals, alkaline earth metals and ammonium with weak acids may be used. Also, organic bases such as the aliphatic amines and their salts with weak acids can be employed.

The aqueous solution may contain as much as 40 per cent. by weight of the base, depending upon the nature of the base used. Preferable concentrations are from 1 to 10 per cent.

Oxygen is stated to be the most effective catalyst for the process. Organic peroxides can also be used. Some of the most suitable are diacyl peroxides, such as diacetyl, dipropionyl, dibutyryl, benzoylacetyl and dibenzoyl peroxides. Other organic peroxides that can be employed include diethyl peroxide, dipropyl peroxide, cyclohexanone peroxide, tetrahydronaphthalene peroxide, and diethyl ether peroxide. Ozone can also be used as the catalyst.

The amount of catalyst that can be employed is in the range from 0.003 to 2 per cent. by weight based on the monomer; the preferred quantity is from 0.03 to 0.3 per cent.

It is stated that the process is advantageously operated in a continuous manner; for example, by passing a mixture of tetrafluorethylene together with the catalyst, such as oxygen and water, through a zone that is maintained under the polymerizing conditions. It is preferable to provide means to agitate the reaction mixture, or subject it to violent turbulence, during polymerization.

Alternatively, the tetrafluorethylene and water can be passed into the reaction zone, and the catalyst injected at this point or at several points in the reaction zone. In this procedure the unreacted tetrafluorethylene is recycled, and that converted to polymer is removed, because the unreacted monomer can very readily be reused and accurate control exercised over the reaction conditions, and there is considerable flexibility in operation and maximum economy.

Corrosion resistant material for the reaction vessels is most desirable, because of the minimum of contamination of the polymer with corrosion products. Vessels constructed of, or lined with, mild steel, stainless steel, silver, nickel or tantalum are satisfactory, but vitreous liners of glass or porcelain may also be used.

General Method of Polymerization

One general method of effecting the polymerization process is given, and employs a high-pressure metal reaction vessel provided with an agitator. It is partially filled with aqueous sodium hydroxide, concentration 5 per cent. by weight. After evacuating, it is charged with sufficient monomeric tetrafluorethylene to give a partial pressure at the reaction temperature of greater than 1,000 lb./sq. in., 1,000 to 4,000 lb./sq. in. being a convenient range. Oxygen equivalent to about 0.06 per cent. by weight of the tetrafluorethylene is next introduced, and then the vessel is agitated and the temperature raised to 80-150 degrees C. for about four hours to effect polymerization. The course of the reaction is followed by the pressure decrease, and when the drop ceases, the vessel is cooled, pressure released, and the polytetrafluorethylene withdrawn as a white, granular solid.

Specific Operating Data

More specific examples of operating are given as below, all quantities being parts by weight:—

(1) A silver-lined high-pressure reaction vessel was a quarter filled with 100 parts of 5 per cent. aqueous sodium hydroxide. It was evacuated and charged with 200 parts of tetrafluorethylene. Oxygen was then introduced to the equivalent of a partial pressure of $\frac{1}{4}$ atm., this being equivalent to 0.096 parts of oxygen, or 0.048 per cent. by weight of the tetrafluorethylene. Next, the temperature was raised to 148-151 degrees C. for 8 hours, during which time the pressure fell from 2,200 to 1,600 lb./sq. in. The vessel was cooled, the pressure released, and the product discharged. The yield was 82 parts of white granular polytetrafluorethylene (41 per cent.).

The aqueous solution at the end of the process was neutral, and contained considerable fluoride ion as sodium fluoride. After removing the fluoride as calcium fluoride, filtering and evaporating the filtrate to dryness, and then extracting this residue with absolute alcohol, sodium difluoracetate could be crystalized from the alcoholic solution in the form of lustrous plates.

The polymer obtained was insoluble in all the usual organic and inorganic solvents. It was not dissolved, attacked or swelled by such chemicals as concentrated nitric acid, concentrated sulphuric acid, concentrated hydrochloric acid, hydrofluoric acid, or by concentrated aqueous caustic alkalies. It was converted into thin, semi-transparent films by subjection to about 400 lb./sq. inch at 400 degrees C., followed by cold water quenching. The film made in this way was very tough and exhibited a tensile strength of the order of 2,500 lb./sq. inch, and did not become brittle at −78 degrees C.

(2) A silver-lined high-pressure reaction vessel was charged one-quarter full with 100 parts of water. After closing and evacuating, 166 parts of tetrafluorethylene were added, and then oxygen equivalent to a partial pressure of 1 atm. The latter corresponded to 0.384 parts of oxygen, or 0.23 per cent. by weight of the tetrafluorethylene. The vessel was then agitated and heated to 100 degrees C. to 106 degrees C. for 8 hours; during this period the pressure fell from 1,550 to 1,150 lb./sq. inch. After cooling and releasing the pressure, the yield was 44

parts of white granular polytetrafluorethylene (27 per cent). The aqueous residue was acid to congo red (pH less than 4), and contained much fluoride ion.

(3) A silver-lined high-pressure reaction vessel was a quarter filled with 100 parts of water and closed. Without evacuating to remove air, 100 parts of tetrafluorethylene was added. The reaction vessel was next heated to 200 degrees C., and there was a consequent rise in pressure to 1,600 lb./sq. inch. After heating for 8 hours, 3 parts of white granular polytetrafluorethylene was obtained (3 per cent.).

(4) A silver-lined high-pressure reaction vessel was charged with 100 parts of water and 0.2 parts of benzoyl peroxide. The pH of the water was adjusted to 3.3 by the addition of one drop of 2 normal aqueous formic acid. The reaction vessel was closed, evacuated, and then charged with 200 parts of tetrafluorethylene. It was next agitated and heated to 79-84 degrees C. for a period of 9 hours. The pressure fell from 1,450 to 1,300 lb./sq. inch. The yield was 17 parts of white granular polytetrafluorethylene (8.5 per cent.).

It will be noted that the same yields are not obtained by processes to B.P. 574688 as with those to B.P. 572265.

Properties of Polymer

The most outstanding feature borne out by the foregoing is the thermal resistance of polyfluorethylene. At normal pressures it does not melt and has an operating temperature of the order of 250 degrees C. In this respect it compares with the thermosetting silicones, and over the latter it has some advantages and, naturally, many disadvantages. However, it is not fair to take the comparison too far, because each type is a class on its own, with its own field of usefulness. However, a parallel can be drawn this far: each is in its infancy, with manufacture only at the pilot plant stage; each is very expensive; and little or nothing has been seen of the materials in this country to date.

Polyfluorethylene is a high-density material, specific gravity 2.0 to 2.5, very much like polythene in appearance. It possesses very good electrical properties, including power loss factor at high frequencies. It is stable and inert and extraordinarily immune from attack by strong chemicals and solvents. It is the answer to many chemical plant problems, supplying the missing link in the form of gaskets, washers, glands and pipe connections for otherwise non-corrodible, or solvent and oil-resisting equipments. Particular applications are for resistance to strong acids and alkalies, solvents and oils. Electrical properties enable it to replace ceramics, including low loss ceramics. Easy machineability enables shapes to be made that otherwise have to be avoided.

Conversion of Granular Solid to Other Forms

With its high temperature resistance, difficulty in passing from the granular solid to other forms is to be expected. The patent information indicates that this is achieved by heat and pressure, i.e., really a sintering effect under high pressure. This applies to blocks, sheets and films, but, presumably, other shapes have to be fabricated by machining from these pressure-compacted blocks and not by moulding; it is assumed, too, that film in continuous length would have to be machined from cylindrical blocks by a process akin to the skinning of wood logs into continuous veneers. The possibilities in these directions of fabrication have, naturally, by no means reached finality. The really interesting phase would be to have this material available in this country to assess its properties. Of the latter, very high mechanical strength must not be overlooked.

It will be seen that polytetrafluorethylene answers the shortcoming of thermal instability in polythene without detracting from chemical, electrical or mechanical qualities, but in part seriously reducing manipulability, an effect to be anticipated.

The chlorinated polythenes have been studied over a longer period than the fluorinated materials. The results have

not been so spectacular and, as far as is known, no products have been exploited as "plastics" commercially. Varnishes having this material as a base have, however, been used, their virtue being very high impermeability to moisture vapour. Patent literature is quite extensive, covering products obtained from the polymerization of chloroethylenes as well as chlorination of ethylene polymers.

Polychloroethylenes

British Patent No. 575,616 (1946) of Imperial Chemical Industries, Ltd., deals with the polymerization of unsymmetrical dichloroethylene. Cross reference is made to previous patents.

B.P. No. 573,369 covers the polymerization of unsymmetrical dichloroethylene itself or in admixture with one or more polymerizable compounds containing the grouping —C = CH —, these other compounds not being present in preponderating amounts. The reaction is achieved in an aqueous medium in the presence of persulphuric acid or water soluble persulphate, and in the presence of a water soluble compound capable of taking up molecular oxygen.

B.P. No. 525,048 proposes the production of interpolymers containing unsymmetrical dichloroethylene by interpolymerizing this material with at least two completely organic substances having the general formula $CH_2=C-R$, in which R is an organic radical having a carbon atom joined to a second and preferably dissimilar atom by more than one bond, the multi-bonded atom being separated from the $CH_2=C-$ group by not more than one chain atom. The interpolymerization claimed is effected in aqueous emulsion using an inorganic persulphate as catalyst.

(To be continued)

BRAIDED NYLON CORD for fabric attachment is the subject of a new addition (D.T.D. 786) to the series of Material Specifications issued by the Ministry of Supply. Requirements are laid down for the selection of test samples. Appendices give methods for the determination of plaits per inch, weight, and breaking strength.

FORTHCOMING EVENTS

February 12. I.P.I. (London). Waldorf Hotel. Luncheon Meeting, 12.30 for 1 p.m. Sir W. Lawrence Bragg, F.R.S. "The Work of the Cavendish Laboratory, Cambridge University."

February 13. I.P.I. (Western). Film Show at works of T. H. and J. Daniels, Ltd., Stroud, 6.30 p.m.

February 13. Dyers and Colourists (West Riding). Great Northern Victoria Hotel, Bradford, 7.15 p.m. Dr. H. P. Staudinger, "Polymer Chemistry."

February 19. I.P.I. (Southern). Polygon Hotel, Southampton. J. L. Daniels, "The Relative Merits of a Self-contained Hydraulic System against Accumulators."

February 21. I.P.I. (Midlands). J. Lloyd (J. B. Broadley, Ltd.), "Coating Fabrics with Plastic."

February 21. I.P.I. (North-Western). Engineers' Club, Albert Square, Manchester, 2. "Costing and Estimating of Mouldings, Compression, Injection and Transfer." Speakers: "Compression"—L. Booker (Robert McArd, Ltd.). "Transfer"—W. Astle (Birkby's, Ltd.). "Injection"—J. Senior (Cascelloid, Ltd.).

February 26. I.P.I. (London). Waldorf Hotel. "Plastics in Art and Decoration." Speaker to be arranged.

March 4. I.P.I. (North-Eastern). Neville Hall, Newcastle, 6.30 p.m. "Laboratory Control in the Manufacture of Laminated Plastics."

March 4. Dyers and Colourists (Leeds Junior). Lecture Theatre, Colour Chemistry and Dyeing Dept., The University, Leeds, 4 p.m. J. G. Grundy, "A Review of Recent Developments in the Textile Industry."

March 7. I.P.I. (Midlands). Luncheon, Botanical Gardens, Edgbaston. It is hoped that the Guest of Honour will be the Lord Mayor of Birmingham.

March 11. S.C.I. (Plastics Group). Royal Society of Tropical Medicine, Manson House, 26 Portland Place, London, W.1, 2.30 p.m. E. G. Williams (I.C.I., Ltd., Plastics Division), "Contact Pressure Laminates."

March 12. Dyers and Colourists (Northern Ireland) Queen's Hotel, Belfast, 7.30 p.m. J. G. Grundy, "The Application and Fastness Properties of Dyes on Nylon."

PATENT REVIEW

The following abstracts have been made from specifications at the Patent Office, with the permission of the Controller of H.M. Stationery Office. Complete specifications can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1/- each.

B.P. 581,627. Application date: 22.9.44. Convention date (U.S.A.): 24.9.43. Accepted: 18.10.46.

Improvements in or relating to the Production of Vinyl and Ethylidene Esters. To: E. I. Du Pont de Nemours and Co.

Refers to the manufacture of these esters by reacting acetylene with a carboxylic acid and in particular to methods which give improved efficiency and a higher output of vinyl ester.

B.P. 581,662. Application date: 4.10.44. Convention date (U.S.A.): 4.10.43. Accepted: 21.10.46.

Improvements in or relating to the Manufacture of Organic Fluoric Compounds. To: E. I. Du Pont de Nemours and Co.

Refers to the production of trihalomethyl ethylenes containing at least one fluorine atom in the trihalomethyl group.

B.P. 581,702. Application date: 1.3.44. Accepted: 22.10.46.

Improvements in or relating to Thermosetting Resins. A. Brookes. To: British Industrial Plastics, Ltd.

Relates to the preparation of thermosetting condensation products of the amino-plastic type. The process comprises condensation under heat of formaldehyde with urea, thiourea or cyanamide polymers, alone or in admixture, or the condensation of methalol compounds derived from these substances, in the absence of water and in the presence of plasticizers (mono-ethers of polyhydric alcohols).

B.P. 581,711. Application date: 8.1.45. Convention date (U.S.A.): 4.3.44. Accepted: 22.10.46.

Improved Method of Drying Artificial Shaped Articles and Masses comprising Regenerated Cellulose or Cellulose derivatives. F. C. Wedler. To: American Viscose Corporation.

B.P. 581,717. Application date: 9.4.45. Accepted: 22.10.46.

Improvements in or relating to Polythene Films. J. R. Myles and D. Whittaker. To: Imperial Chemical Industries, Ltd.

Chlorination of polythene film under the influence of actinic light. Although the main properties of polythene are preserved (impermeability to moisture, inertness to chemicals, etc.), the superficial layer of chlorinated polythene has a high power factor (0.05-0.2); polythene so treated is thus suitable for high frequency welding.

B.P. 581,751. Application date: 21.4.44. Convention date (U.S.A.) : 22.4.43. Accepted: 23.10.46.

Coating of Solid Organic Polymers with Polysilicic Acid Esters. To: E. I. Du Pont de Nemours and Co.

B.P. 581,897. Application date: 25.3.43. Accepted: 29.10.46.

Improvements in or relating to the Manufacture of Polymeric Substances containing Fatty Oil Acid Radicles. D. H. Hewitt and F. Armitage. To: Lewis Berger and Sons, Ltd.

Production of polymers containing fatty oil acid radicles by heating a polymeric acrylic or alphamethacrylic acid ester with a non-hydroxylated fatty oil acid ester of a polyhydric alcohol in the presence of a catalyst such as litharge.

B.P. 581,899. Application date: 12.4.43. Convention date (U.S.A.): 10.4.42. Accepted: 29.10.46.

Improvements in or relating to Polymerization Products. To: Imperial Chemical Industries, Ltd.

Refers to a new type of reaction called telomerization and to the reaction products called telomers (terminal substituted polymers). This process for the preparation of telomers consists in subjecting one or more polymerizable aliphatic mono-olefinic hydrocarbons (ethylene) and a substance such as a saturated aliphatic ester of an inorganic oxy acid of sulphur, phosphorus or silicon, to a temperature between 60 degrees and 150 degrees C. and a pressure between 20 and 2,000 atmospheres in the presence of a percompound as catalyst.

B.P. 581,901. Application date: 12.4.43. Convention date (U.S.A.): 10.4.42. Accepted: 29.10.46.

Improvements in or relating to the Manufacture of Chlorinated Olefines. To: Imperial Chemical Industries, Ltd.

Refers to the manufacture of chlorolefines and chloroacetylenes.

Leaves from a Moulder's Notebook

This is the third in a series of notes by the B.I.P. Development Department on the problems of the moulder and designer. B.I.P. will send a copy of previous notes on request and will welcome comments and enquiries.

Transfer Moulding—1

As is well known, transfer moulding is the adaptation of the injection principle to the moulding of thermo-setting materials. The purpose of this and subsequent notes is to indicate some of the advantages of the transfer method, and also to call attention to certain problems which may arise in practice.

Advantages of the Transfer Method

Transfer moulding may suitably be adopted when the compression method would be difficult or impracticable owing to awkward shapes, deep holes, heavy inserts or thick or intricate sections. However, even if the article is a simple shape, such as a clock case involving none of these complications, it may still be desirable to choose transfer moulding, because of its inherent virtues. By permitting correct, even and rapid heating before flow, transfer moulding can remedy common troubles such as flow and gas marks. Moreover, by the proper application of pressure, transfer moulding can reduce wastage by flash compared with the compression method.

The Problem of Pressure

As in compression moulding, the main essential in transfer moulding is to apply pressure correctly to a correctly designed mould. In compression moulding, a positive mould will produce a thick moulding if overloaded, and the tool designer therefore uses a semi-positive mould for an article of awkward section, with flash or sprue grooves which allow the necessary slight overloading needed to ensure a full moulding.

Similar reasoning may be applied to the transfer method. When moulding material spews out between the flash faces before it reaches the cavity, the designer knows that the injection pressure is sufficient or spew would not occur, but the locking pressure may be suspect. If he is satisfied that this is adequate, the reason why the material fails to reach the cavity is either because the feed or feeds are not large enough, or the cavity is too far from the gate.

Size of Feeds and Gates

An increase in the size of the feeds will allow of reduction in the locking pressure owing to easier passage of the material to the cavity. On the other hand, larger feeds will result firstly in a greater wastage in the form of sprues, and secondly in the need for a longer cure owing to loss in heat of the material through greater dispersal and reduced friction.

Similarly, small feeds and gates will necessitate greater injection pressure, and also greater locking pressure to prevent the material from escaping by forcing the mould faces apart.

Feeds and gates which are too small may also cause non-adherence to dimensions across the parting line and excessive shrinkage in the moulding.

The problems of shrinkage and distortion in transfer moulding will be discussed in the next leaf from the notebook.

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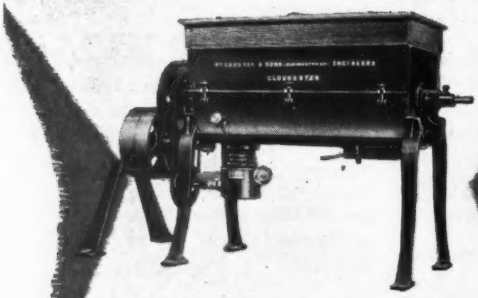

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B.P. 581,907. Application date: 29.9.43. Accepted: 29.10.46.

An Improved Manufacture of Ethyl Benzene. To: Standard Oil Development Co.

This manufacturing process involves the steps of subjecting a mixture of benzene, ethylene and anhydrous hydrogen fluoride to a temperature above atmospheric, maintaining the mixture at this temperature for a sufficient time to produce a substantial amount of ethyl benzene and separating the latter from the reaction product.

B.P. 581,995. Application date: 9.12.43. Accepted: 31.10.46.

Improvements in or relating to the Manufacture of Co-polymerization Products. J. J. P. Staudinger and C. A. Brighton. To: The Distillers Co., Ltd.

Preparation of improved co-polymerization products from vinyl chloride and an ester of an ethylene and alpha-beta-dicarboxyl acid.

B.P. 582,010. Application date: 20.3.44. Convention date (U.S.A.): 20.3.43. Accepted: 1.10.46.

Polymerization of Methyl Methacrylate in the presence of Aliphatic Thiols. To: Imperial Chemical Industries, Ltd.

Refers to methyl methacrylate polymers specially useful in moulding operations, comprising the dispersion of monomeric methyl methacrylate and .01-3 per cent. by weight of an aliphatic thiol (beta-hydroxyethane thiol) in water and maintaining the dispersion at a temperature of at least 100 degrees C. under pressure until the methyl methacrylate is polymerized.

B.P. 582,013. Application date: 6.4.44. Convention date (U.S.A.): 10.4.43. Accepted: 1.11.46.

Improvements in and relating to Polyvinyl Alcohol Filaments. To: Johnson and Johnson, Ltd.

Polyvinyl alcohol filaments particularly suitable for suturing. These filaments have a high wet strength. They are stretched after extrusion whilst they are still plastic and are subsequently heated, being maintained in the stretched condition. The moisture content is kept constant, thus preventing the loss or gain of moisture.

B.P. 582,019. Application dates: 13.5.44 and 14.5.45. Accepted: 1.11.46.

Improvements relating to the Manufacture of Organic Pigments and Moulding Powders. L. A. Lantz and A. Schofield. To: The Calico Printers Association, Ltd.

B.P. 582,134. Application dates: 30.3.42, 25.6.42, 13.1.43. Accepted: 6.11.46.

Improvements relating to the Production of Polystyrene. B. T. D. Sully. To: A. Boake, Roberts and Co., Ltd.

Process for the polymerization of styrene in aqueous dispersion in the presence of sulphites oxidizable by free oxygen. The reaction is carried out in the presence of air or of an inert gas mixed with oxygen. Catalysts (salts of copper, iron, molybdenum or cobalt) are employed. This process yields high molecular weight polymers (M.Wt. 200,000-500,000).

B.P. 582,157. Application date: 5.1.45. Accepted: 8.11.46.

An Improved Water Dispersible Urea Formaldehyde Composition and its Preparation. H. F. Rance, G. F. Glover and E. J. Pritchard. To: Wiggins, Teape and Co. (1919), Ltd. See also B.P. 582,235.

Water dispersible composition produced by combining a urea formaldehyde partial condensate with rosin (in the form of an alkaline solution or alkali soap of rosin) and also with an alkaline solution of casein.

B.P. 582,167. Application date: 28.8.44. Convention date (U.S.A.): 26.8.43. Accepted: 8.11.46.

Improved process for the Polymerization of Esters of Acrylic Acid and derivatives thereof. To: Imperial Chemical Industries, Ltd.

Casting of shaped articles by polymerizing methyl methacrylate in bulk in the presence of a mixed catalyst (benzoyl peroxide + sulphur dioxide + methallyl alcohol + methallyl chloride). Advantages claimed are smooth polymerization and freedom from voids or flaws.

B.P. 582,235. Application date: 10.8.44. Accepted: 8.11.46.

An Improved Water Dispersible Casein Urea Formaldehyde Composition and its preparation. G. F. Glover. To: Wiggins Teape and Co. (1919), Ltd.

Water dispersible composition produced by combining a urea-formaldehyde partial condensate with an alkaline solution of casein at boiling point. This composition may be used in paper making.

B.P. 582,247. Application date: 1.2.44. Accepted: 11.11.46.

Improvements relating to the Manufacture of Moulding Powders and Moulded Articles therefrom. H. A. Collinson. To: Leicester, Lovell and Co., Ltd.

Urea-formaldehyde moulding powder pro-

duced by refluxing or distilling urea and formaldehyde at atmospheric pressure under acid conditions until a viscous syrup is obtained, then adjusting the pH to between 7 and 8 and spray drying in an atmosphere of about 100 degrees C. and finally dry mixing the powder so obtained with fillers and catalysts.

B.P. 582,248. Application date: 4.2.44. Accepted: 11.11.46.

Improvements in the Moulding of Optical Elements from Synthetic Resins. C. H. Crooks, W. A. Greenwood, D. Starkie, H. Silber. To: Imperial Chemical Industries, Ltd.

Refers to the manufacture of polymethyl methacrylate and polystyrene lenses, prisms and mirrors.

B.P. 582,266. Application date: 28.7.44. Accepted: 11.11.46.

Process for the Production of Polymers. P. Davies, D. K. Peacock and J. E. Fearey. To: Imperial Chemical Industries, Ltd.

Production of solid polymers of isobutylene oxide by treating the monomer in the liquid phase at a temperature not higher than 12 degrees C. with a Friedel-Craft catalyst. Stabilizers are used, examples quoted being: hydroquinone, aniline, phenyl-beta-naphthylamine, etc.

B.P. 582,284. Application date: 29.8.44. Accepted: 12.11.46.

Improvements in the Manufacture of Articles made from Cellulose Acetate. C. Diamond and A. Hill. To: Courtaulds, Ltd.

Cellulose acetate of improved resistance to plastic flow at raised temperatures and improved flexibility at low temperatures with an acetyl content of more than 56 per cent. and not more than 61 per cent. cellulose acetate (1 part) plasticized with 1-2½ parts of plasticizer, e.g., di-methoxyethyl phthalate.

B.P. 582,327. Application date: 19.7.43. Accepted: 13.11.46.

Improvements relating to the Production of Polystyrene. B. T. D. Sully. To: A. Boake Roberts and Co., Ltd.

Process for the polymerization of styrene in aqueous dispersion in the presence of free sulphur dioxide and a metal catalyst. See also: B.P. 582,134.

B.P. 582,334. Application date: 19.1.44. Convention date (U.S.A.): 19.1.43. Accepted: 13.11.46.

Production of Solid and Semi-solid Polymers and Interpolymers of Ethylene. To: Imperial Chemical Industries, Ltd.

Manufacture of solid polymers of ethylene by polymerizing specially purified ethylene at pressures between 500 and 3,000 atmospheres and a temperature between 60 degrees and 400 degrees C. The ethylene is produced by dehydration of ethanol. It is then purified, so that it does not contain more than 0.2 per cent. of hydrogen.

B.P. 582,348. Application date: 24.5.44. Convention date (U.S.A.): 24.5.43. Accepted: 13.11.46.

Improvements in or relating to the Production of Polymeric Materials. To: Imperial Chemical Industries, Ltd. See also: B.P. 577,511.

Chlorination of a co-polymer of vinyl chloride and trichlorethylene until it contains from 64-66 per cent. of chlorine. The resulting product is more heat stable and has a better solubility in lacquer solvents and also has a higher softening temperature.

B.P. 582,448. Application date: 17.3.44. Accepted: 18.11.46.

Improvements relating to the Manufacture of Synthetic Resins. P. H. Rhodes.

Manufacture of resorcin-aldehyde resins by heating together resorcin and formaldehyde in the proportion of less than one mol. of aldehyde to one mol. of resorcin, adding a catalyst when the preliminary condensation is almost complete and continuing the heating process to remove water from the reaction product. The resins so obtained are brittle and permanently fusible; they may be cured at comparatively low temperatures. Uses mentioned are plywood, abrasive articles, mouldings.

B.P. 582,517. Application date: 13.5.44. Accepted: 19.11.46.

Modification of the Properties of Articles derived from Nylon. J. R. Lewis and D. McCreath. To: Imperial Chemical Industries, Ltd.

Relates to modified filaments, bristles, yarns, films and the like produced from nylon and refers more particularly to articles modified by reaction with formaldehyde and an alcohol; treatment with formaldehyde is carried out until the nylon contains at least 4 per cent. of combined formaldehyde.

B.P. 582,518. Application date: 15.5.44. Accepted: 19.11.46.

Modification of the Properties of Filaments, Bristles, Yarns, Films and like shaped Articles derived from Nylon. J. R. Lewis. To: Imperial Chemical Industries, Ltd.

Similar to B.P. 582,517. The modification in this case consists in treatment with formaldehyde or an organic diisocyanate. The treatment is continued until a substantial proportion of the molecules is cross-linked; the articles so treated are then heated in the presence of an alcohol, formaldehyde and a catalyst until the nylon contains at least 4 per cent. of combined formaldehyde.

B.P. 582,520. Application date: 15.8.44. Accepted: 19.11.46.

Modification of the Properties of Filaments, Films and other shaped Articles derived from Nylon. J. R. Lewis, D. McCreath and R. J. W. Reynold. To: Imperial Chemical Industries, Ltd.

Modification of nylon bristles, filaments and the like by reacting the undrawn nylon article with formaldehyde and alcohol in the presence of an acidic catalyst. The alcohol and the formaldehyde are in the form of vapours.

B.P. 582,522. Application date: 29.9.44. Accepted: 19.11.46.

Modification of the Properties of Filaments, Bristles, Yarns, Fabrics, Films and like shaped Articles derived from Nylon. J. R. Lewis and G. Loasby. To: Imperial Chemical Industries, Ltd.

Similar to B.P. 582,517, B.P. 582,518 and B.P. 582,520 but differs in how the process is carried out. The articles, which are completely or partially oriented by drawing and afterwards disoriented by a shrinking treatment, are heated in the presence of an alcohol formaldehyde and an acidic catalyst.

B.P. 582,571. Application date: 25.3.43. Convention date (U.S.A.): 28.3.42. Accepted: 31.11.46.

An improved Manufacture of Diolefin Co-polymers. To: Standard Oil Development Co.

Preparation of olefinic co-polymers by emulsion polymerization of butadiene-1, 3-chloroprene, isoprene, piperylene or 2, 3-dimethyl butadiene and paramethyl styrene or paramethyl alpha methyl styrene. Sodium oleate or sodium lauryl sulphate is used as emulsifier and hydrogen peroxide, potassium persulphate, sodium perborate or benzoyl peroxide as polymerization catalyst.

B.P. 582,614. Application date: 26.7.44. Convention date (U.S.A.): 12.11.43. Accepted: 21.11.46.

Improvements in Adhesive Compositions. U.S. Rubber Co.

Self-curing butyl rubber cement for cementing natural rubber, synthetic rubber-like materials, etc., to themselves, to each other and also to materials such as leather, metal, phenolic resins and urea formaldehyde resins. The adhesive composition consists of an organic solvent medium, butyl rubber, an organic compound which readily liberates a halogene (N-chloroamide or a chlorinated hydantoin) and a vulcanizing agent for butyl rubber, for instance, para-benzoquinone dioxide.

B.P. 582,641. Application date: 28.7.44. Convention date (U.S.A.): 29.7.43. Accepted: 22.11.46.

New Sizing Compositions. To: Imperial Chemical Industries, Ltd.

Sizing compositions containing hydroxylated polyvinyl resins used for the sizing of yarns.

B.P. 582,649. Application date: 3.8.44. Accepted: 22.11.46.

Improvements in and relating to the Manufacture and Production of hollow articles from a Thermoplastic Cellulose derivative. H. M. Averns. To: Courtaulds, Ltd.

Manufacture of hollow articles (for instance, toys) from a thermo-plastic cellulose derivative such as cellulose acetate, by heating flat pieces of the thermo-plastic material containing a plasticizer and a solvent for the cellulose acetate, in an enclosed space at a temperature above the boiling point of the solvent. This method of production avoids the use of moulds.

B.P. 582,663. Application date: 8.12.43. Convention date (U.S.A.): 17.6.42. Accepted: 25.11.46.

Production of polymeric organic Compounds containing Chlorine. To: Imperial Chemical Industries, Ltd. See also B.P. 581,899.

Telomerization of compounds with an ethylenic double bond (vinyl compounds or halogenated olefines) containing at least 5 per cent. of hydrogen chloride, by subjecting them to elevated temperatures and pressures in the presence of a catalyst.

B.P. 582,698. Application dates: 21.9.44 and 14.4.45. Accepted: 25.11.46.

Improvements in or relating to Methods of Attaching Soles to Shoe Bottom by means of Rubbery Cement and Apparatus adapted to produce a tempering atmosphere for treating Soles prior to such Cement Attachment to Shoe Bottoms. To: B.B. Chemical Co., Ltd.

The Microscopic Examination of Plastic Materials

VI.—Mouldings (Fillers)—(d) Comparison of Different Grinding Methods

By J. H. WREDDEN, F.R.M.S.
(Chief Chemist, Igranic Electric Co., Ltd.)

In the contribution published in our January issue, the author commenced a series of photomicrographs to show that the type and structure of wood flour indicate largely the method of reduction to be employed to produce the most suitable end product, although so far there has not been any indication of possible improvements which may be brought about by different grinding techniques applied to the one material.

The author has been fortunate to secure samples of Swedish softwood flour ground by non-standard methods, with a view to producing a particle shape more nearly approaching the ideal concept previously discussed. Unfortunately, the details of the method used are not disclosed, so that we have to rest content in the knowledge that the method is somewhat unorthodox. His previous contribution discussed briefly the results produced by the two methods.

IMPROVEMENT obtained by the suggested new technique in grinding may not be wholly due to the adoption of that technique; it is quite likely that improvement in variability is due to more careful screening. A little thought on this question of screening and mesh size will show that the designation in common use, i.e., "mesh size," is incomplete and sadly lacking in ability to convey accurate information regarding the true nature of the product. We have seen that it is possible to designate, quite correctly, two wood flours whose particle morphology is so different that they may be regarded as being at the two extremes of particle shape available, but apart from this the variability index has shown that a flour graded as 80 mesh may quite possibly contain a high percentage of finer mesh sizes. It would appear, therefore, that a closer degree of tolerances would be desirable in helping to produce a more consistent product, which, in turn, would produce more consistent characteristics in the finished moulding; for example, a particular flour may be graded as 80 mesh, which would mean that the whole of it will pass through an 80 mesh sieve, but unless we are told the mesh of the finer sieve which will stop it completely, there is insufficient information upon which definite conclusion may be based.

It seems probable that one of the major factors influencing the production of really consistent particle size in these filling materials is this question of screening; it is clear that, in order to achieve this object, the mesh size of the screen which lets 100 per cent. through must be as close as possible to that which stops it completely. In other words, the designation of a single mesh size is not sufficient; it is desirable that the grading indicates a range, such as "between 80 mesh and 100 mesh." If this course were adopted, one would immediately know that the flour so classified would pass through an 80 mesh screen and be stopped by a 100 mesh screen, thus giving some indication of the nature of the flour with respect to its variability.

On the other hand, with the present system of designating in most cases a flour by single mesh size, it is possible to obtain a number of materials differing in properties to an extent not desirable under the common classification of one

mesh number, and it is probable that this state of affairs is largely responsible for the inconsistent results given by tests on mouldings produced from material intended for the production of articles having similar physical properties. At the same time, consistency of particle shape must not be overlooked, although this characteristic of a filler would not appear to be so important as particle size; however, inconsistent particle shape must inevitably add its quota to the overall effect on the end product and as such must be taken into consideration.

It would appear that methods used in reducing the wood to flour play an important part in the production of a filler possessing the most desirable characteristics to the greatest degree. In view of this it should be of interest to examine samples of softwood flour produced in America, where the methods used for grinding the sawdust are different from those used in this country or on the Continent. Fig. 148 shows 30 mesh wood flour of American origin, the photomicrograph being taken at 34 diameters under polarized light with the system crossed. This flour may be seen to consist of two sizes of particle, and those shown in this illustration may be regarded as being the larger of the two, three such particles typifying this group being A, B and C.

It should be realized that the flour, as a whole, being rated as 30 mesh is rather coarse as wood flours go; in fact, it is difficult to define the point where sawdust becomes wood flour. Dahl* has given it as his opinion that sawdust becomes wood flour after it has been subjected to any kind of treatment involving its reduction in particle size, such as would be experienced by grinding, and as the sample under consideration is marketed as wood flour, it must be assumed that it is the result of grinding sawdust.

In the light of this assumption it is interesting to note that the particles A, B and C show distinct signs of having been subjected to a grinding operation,

Fig. 148.—American softwood flour (30 mesh), taken by polarized light with system crossed. Mag. 34 diameters.

for it will be noticed that, whereas the ends appear to be square cut, they are beginning to show signs of being somewhat rounded, and the ends marked a and b are also showing signs of defibration. This morphology of the particle end is seldom met with in specimens taken from unground sawdust, where the ends of the particles are more usually square, and show distinct signs of the influence of the saw, their appearance being somewhat akin to the end of particle D, although even at this early stage in the process this is also showing signs of the influence of grinding.

In view of the nature of these larger particles and also the mesh size of the flour, it is clear that the material has been separated from the main bulk undergoing grinding at an early stage in the proceedings, hence the appearances just described. This contention is supported by the appearance in the flour of a proportion of particles which have clearly experienced the grinding process to a greater degree than the previously mentioned particles. Two of these latter are seen at E and F, which particles are somewhat smaller in size compared with the first particles discussed; also, their ends are seen to be showing much more positive evidence of true defibration by their frayed appearance, which augur

* W. S. Dahl. "Wood Flour."

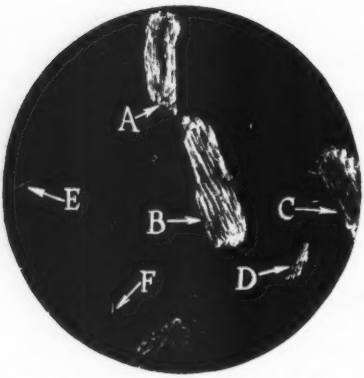

Fig. 149.—American softwood flour (30 mesh), polarized light, system crossed. Mag. 34 diameters.

well for the further effect of the grinding method used. A further slight indication of this is given by the presence of a small bundle of tracheids seen at G. This, although not so clearly visible, may be distinguished as being composed of portions of three or four almost completely separated tracheids.

Having noted the preponderance of two major sizes of particle in this flour, let us examine some of the smaller ones. In Fig. 149 we see a photomicrograph of some of the particles at a magnification of 34 diameters, and under the same conditions of illumination as previously used. Three particles, typical of this size, are shown at A, B and C, and whereas we saw particles of a similar size in the previous illustration, those under discussion are seen to be lacking in the degree of defibration at the ends shown by the former; in fact, the condition of the ends of these particles shows a marked similarity to that of the ends of the large particles in Fig. 148, thus pointing to the fact that defibration has only proceeded to the same extent as that experienced by the larger particles. This leads one to the conclusion that, whereas the more highly defibrated particles are possibly the result of the division or breaking up of larger particles by the grinding process, the small particles which do not show the same degree of defibration are, in all probability, of very much the same size and shape as they originally were as units of the unground sawdust.

This hypothesis could lead one to some interesting speculation regarding the efficiency of grinding methods, for it is clear that as the flour under examination has been subjected to some grinding, it must have been separated from the product issuing from the output side of the grinding mechanism, whatever its nature. Moreover, as such, it must be a proportion of total bulk, all of which had passed through the machine, from which we are entitled to ask what proportion of the total does this material constitute, which consists in the main of relatively large particles scarcely touched by the grinding? At the same time, speculative thought could be centred round the question of the possibility or probability of producing a material of a consistent particle size, from a raw material of a similar consistency, in a single passage through the machine, although it should be borne in mind that in the case under consideration, the raw material, being in all probability sawdust, would have very inconsistent particle size, resulting in a similar inconsistency after grinding.

It would, therefore, appear that the more consistent the particle size of the raw material, the higher the grinding efficiencies obtainable, and in spite of these remarks being mere conjecture, it does seem to indicate the necessity for further investigation into problems regarding the efficiency of grinding methods as applied to the production of wood flour. It will be obvious that if we desire to produce a certain quantity of wood flour of consistent particle size, and could do so by passing a similar quantity of raw material through the grinding machine, then the need for using separating methods to obtain this quantity of the desired material from many times the quantity of raw material would be obviated, resulting in lower production costs for possibly a higher-quality product.

Seen in Fig. 149 are also some very small particles, such as those shown at

D, E and F. These would appear to be either complete single tracheids, or portions thereof, and may be considered to constitute a proportion of the flour as a whole, corresponding in nature to the very fine dusts seen in flours previously examined, but this does not mean that they function as impurities; it is more probable, in this case, that they are, or at least behave as true flour elements, although of diminutive size. Their chief effect would presumably be to widen the variability ratio of the material and thus make it somewhat inconsistent, but as against this we must not overlook the fact that in this particular flour, the proportion of these very small elements is not great, and it is conceivable that any effect produced by them in this direction would be so small as to be unnoticeable. Their effect, however, may be shown by a consideration of the variability index of this material, this latter being 10 when these small particles are ignored and 116 when they are taken into account.

It will be seen that although the variability index gives a guide as to the consistency of particle size in any particular flour, it should be used in conjunction with the proportions of the constituents of various sizes, so that it may develop its full usefulness. However, taken generally, this 30 mesh product is seen to be unusually clean and reasonably consistent in particle size, which property when considered with the distinct signs of defibration, indicates a product of fairly high standard of quality, although it should be borne in mind that the material is of a coarse mesh, as wood flours go, which would make its separation within close limits a comparatively simple matter.

Bearing this in mind, suppose we examine a product of somewhat finer mesh, obtained from the same source. In Fig. 150 we see a photomicrograph of 60 mesh American wood flour at a magnification of 34 diameters. It will be noticed that this material contains a greater variety of particles of different sizes than the sample previously examined, the most notable feature being the increase in proportion of the particles of very small size. In general, the sizes of particles met with may be segregated into three main groups. Those marked A, B, and C may be regarded as typifying a proportion of the flour consisting of large particles; D and E would be typical of a medium-sized group; and F is representative of the very small particles.

Fig. 150.—American softwood flour, polarized light, system crossed. Mag. 34 diameters.

The presence of these groups of various sizes show the flour to be heterogeneous in nature, as each type of particle is present in sufficient quantity to enable it to exert an appreciable influence on the characteristics of the final product. Thus the percentage of the very small particles is much higher than in the case of the flour previously examined, and their influence has to be taken into account as it is now far from insignificant; in fact, this material exhibits much the same state of affairs as was found in the case of the walnut-shell flour, albeit the differences between the groups are not so great with regard to the nature of the material, but morphological differences between the groups are considerable.

This general view of the flour, however, shows a greater degree of true defibration than was found in the 30-mesh material. In Fig. 151 we see the "A" particle of Fig. 150 at a magnifica-

tion of 78 diameters, under the same conditions of illumination. It immediately becomes apparent that even in this small group of particles there are representative examples of a number of stages in the defibrating process, for at " A " we have one of the large particles which does not appear to have suffered much in the grinding, although there are signs of the commencement of defibration at the ends. This particle and its morphology may be taken as being typical of those in the group which it represents, the same applying to the particle marked " B."

Representative particles of the medium-sized group are shown at " C " and " D," of which particle " C " is clearly seen to be in a more advanced state of defibration than either of the first two. It also exhibits the typical strain pattern where it is under stress due to having been bent. In the particle marked " D " we encounter the familiar effect shown by partial defibration of a bundle of tracheids, which leaves part of the bundle almost complete, while its continuation consists of one or more separated elements. This condition was met with when dealing with the softwoods ground by the new technique discussed in the January issue of " Plastics," and in view of the conclusions arrived at regarding the efficacy of this latter method, in so far as the production of defibration is concerned, it would appear that the grinding method employed in the manufacture of this American wood flour is similarly effective in this direction.

An idea of the degree of defibration to be encountered in this material may be obtained by an examination of the group of small particles representative of the third main group, indicated at " F," which clearly demonstrates the presence of a number of tracheids which have not been produced by the reduction of the parent material. These are seen to consist of single tracheids, although it should be borne in mind that they are, in all probability, incomplete, as they are considerably shorter than the normal

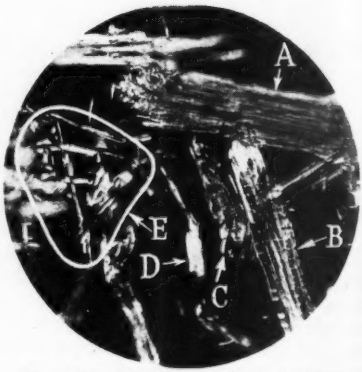

Fig. 151.—American softwood flour, polarized light, system crossed. Mag. 78 diameters.

softwood tracheid; this would be due to the length being reduced in the first instance, due to the action of the saw. However, there would appear to be no doubt that they are portions of single tracheids, for if their diameters are compared with those of the tracheids in evidence in the particle marked " B," they will be seen to be substantially the same.

It will be appreciated that, if we could produce a material consisting entirely of elements such as appear in this group, then that material would function as a very efficient filler. We have seen, as a result of previous examinations, that a flour element such as this is highly desirable, but its full effect could not, presumably, be developed unless it was in the form of a pure flour. A material such as this, however, would be of a smaller particle size (possibly about 120- to 150-mesh), but if it is capable of producing more consistent mouldings, there should not be any objection to its use as a filler, for we know that a flour of a mesh number such as this would also produce a good finish.

In this case, however, these particles being, as they are, a portion of the whole, merely serve to broaden the variability index and probably exert very little beneficial influence on the characteristics of the flour in general; in fact, it is con-

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Table 1.

Group	Variability Index
1. Large particles	2.65
2. Medium sized particles	3.6
3. Small particles	1.65

ceivable that they might actually function as a diluent.

The effect of these small particles may be well illustrated when an analysis of this flour is made. With respect to the variability index, it will be apparent that, as the material may be separated into three groups of particle size, then it will be possible to develop a variability index for each group. These are as shown in Table 1, where it will be noticed that all the indices are low, thus indicating that the groups, when considered as separate individuals, are of a high order of consistency, so far as this characteristic is concerned.

If now we find the variability index for the flour treated as a whole, and ignore the very finest dust-like particles, we are faced with a different state of affairs, for the figure becomes 32.0. This large increase is due largely to the presence of the particles under the third main group; that is to say, the small ones. That this is so may be shown by taking a variability index for the flour, as if it consisted only of the first two groups, i.e., the large and medium-sized particles, the figure then becomes 9.6. A clearer view of the effect of the third group may be obtained if all these results are tabulated together, as in Table 2, from which it will be seen that the index steadily becomes larger towards the bottom of the table. The percentage by which this characteristic degenerates, when taken on figure for the third group, needs no emphasis.

Table 2.

Group	Variability Index
1. Large particles	2.65
2. Medium particles	3.6
3. Small particles	1.65
Groups 1 and 2	9.6
Whole flour	32.0

In dealing with heterogeneous materials such as this, we therefore see that it is not sufficient to take the variability index for the flour as a whole and leave it at that; rather it is that the constituents should be dealt with in separated groups as just explained, not forgetting the necessity for taking into consideration the proportionate quantities of each group present, for whereas the variability indicates the morphology of the flour and its conditions, the effects produced by varying quantities of any separate groups present are not taken into account. So that in the case under discussion, we may look upon the flour as a blend of three different types by virtue of the possession of different particle sizes.

Table 3.

Group	L.B. Ratio
1. Large particles	5.5
2. Medium particles	3.8
3. Small particles	5.1
Groups 1 and 2	4.0
Whole flour	4.0

If we deal with the flour in the same manner as for the variability ratio, we obtain the figures shown in Table 3, from which we see that, on the whole, the ratio of the length of particle to its breadth is fairly consistent. The average of these figures is 4.4, which means that in all cases the flour particle for this particular sample is about four and one-half times its breadth, which, although it is not as long as it might be, indicates a considerably better shape of particle than would be the case if the figure were unity. In general, this 60 mesh material may be considered as being somewhat mixed and would probably be greatly improved, regarding its heterogeneity, by more careful separation.

Having dealt with flours of 30 and 60 mesh, let us continue our examination of these American flours by a consideration of some 80 mesh material. Whereas the previous two samples provided informa-

Fig. 152.—American softwood flour, large particles (80 mesh), polarized light, system crossed. Mag. 34 diameters.

tion with regard to the material in its coarser forms, that now under our scrutiny is used chiefly for filling moulding powders.

This 80 mesh material may be dealt with in much the same way as the others. For example, it may be split up into three basic groups according to particle size. In Fig. 152, we have a photomicrograph of some of the large elements to be found in this flour; these are shown at 34 diameters. It will be noticed that the magnification is the same in this case, so that a comparison as to relative particle size may be obtained directly from the illustrations. This shows how, as the mesh size increases, the general particle size decreases, so that in this case those particles which may be looked upon as belonging to the first group are more or less equivalent to the medium-sized particles in the two previous cases. Three of these, shown at A, B and C, demonstrate clearly that, in spite of a general reduction in size, and presumably being subjected for a longer period to the grinding process, there is very little evidence of defibration, as the ends of the particles are still relatively square cut, although the particle marked "A" does appear to have been more roughly handled than the other two, for there are signs of a degree of defibration along the body of the element and also at the ends.

Continuing with the examination of this flour, Fig. 153 shows some of the particles which may be regarded as belonging to the second group. There are two groups of these particles present, marked "A" and "B"; those in group A are seen to exhibit few (if any) signs of defibration, but those in group B show definite evidence of this having occurred. This seems to point to the necessity for further sub-dividing this group into one consisting of those particles which do not show signs of defibration, and another embracing those which do.

These two illustrations of this 80 mesh flour show the presence of a relatively large proportion of the small elements belonging to the third, and we have seen that these elements also appear in the two previously examined flours. Therefore suppose we examine them a little more closely with a view to obtaining some more information. Some of these are illustrated in Fig. 154 at a magnification of 100 diameters, from which it will be seen that whereas in general they are portions of single tracheids, there are among them particles of similar length

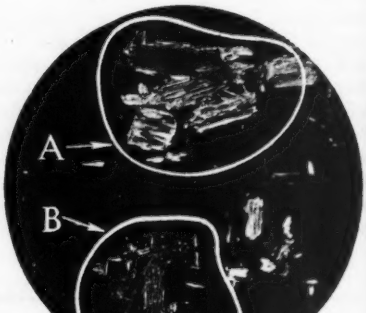

Fig. 153.—American softwood flour, medium particles (80 mesh), polarized light, system crossed. Mag. 34 diameters.

which are portions of bundles of two or three tracheids, such as the one shown at A, although the proportion of such particles in this group of the flour would not appear to be large enough to have any pronounced effect.

In dealing with these flours, although it has been shown that they may be generally regarded as consisting of three groups of material of different mesh sizes, it should be remembered that no hard and fast rule can be applied nor any sharp line of demarkation be drawn between the groups, as there is no doubt that owing to the nature of the material, and the indeterminate morphology of the particles in question, overlapping from group to group must inevitably occur. The classification has, however, been of considerable help in providing us with a picture of the material which could not have been obtained without its use.

This wood flour may, of course, be analysed in the same way as the previous examples, producing the results shown in Table 4. These results show a certain degree of consistency with the figures for the other flours; for example, that for the first two groups in this material is almost identical with the same figure for the 80 mesh flour.

Table 4

Group	Variability Index
1. Large particles	4.7
2. Medium particles	2.6
3. Small particles	1.4
Groups 1 and 2	9.0
Whole flour	23.0

The variability index for Group 1 in the 80 mesh flour is, however, very nearly twice as large as that for the 60 mesh. If these two groups were considered on their individual merits as filling materials, the honours would go to Group 1 of the 60 mesh flour. With regard to the other two groups of 80 mesh material, there is very little difference, and they may be regarded as being the same for both the 60 and 80 mesh flours. The main point, however, is not so much the small differences between the groups, but the fact that

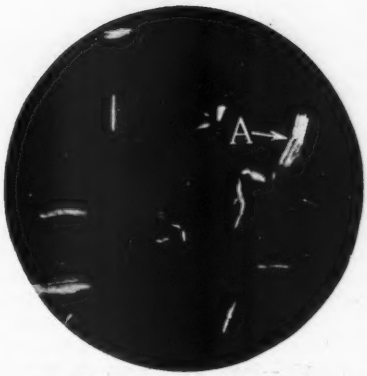

Fig. 154.—American softwood flour, small particles (80 mesh), polarized light, system crossed. Mag. 100 diameters.

the groups exist at all. That these flours may be so easily split up is indicative of a mixed texture of relatively wide range, which might be capable of producing very inconsistent characteristics, for we have already seen the effect of the presence of Group 3 material on the variability index, and it is clear that as the proportion of this group varies so will the variability of the flour. A good example of this appears to be given by the 80 mesh material, where the Group 3 index is almost identical to that for the 60 mesh flour, but in spite of this, the index for the whole flour is considerably lower than that for the 60 mesh. So that it is desirable to stress once again the importance of using the variability index in conjunction with the proportions present of the various groups.

In general it would seem that these flours show a high degree of defibration, but the variability indices indicate them to be of mixed texture, this in all probability resulting from the use of a wide range of mesh members in the separation.

This question of screening assumes some importance in the production of wood flour; therefore it appears advisable to examine it a little more closely. It is proposed to take samples of beech wood flour for this purpose, one of which is

Fig. 155.—Beech wood flour, unground but separated from sawdust (80 mesh), polarized light, system crossed. Mag. 34 diameters.

illustrated in Fig. 155. This photomicrograph shows some beech wood flour which has not been ground, but separated from the raw sawdust by sieving, no great care being taken of this operation. This particular sample produced a variability index of 35 for the whole flour, which, in view of the preponderance of large particles, points to the presence of at least some fine material, although this latter might be in small proportion; and on the face of it we would be justified in classing this material as a reasonably consistent flour, with a small proportion of fine material present, this accounting for the high index.

It should, however, be remembered that the material was separated from a parent which normally contains, or is expected to contain, only a small proportion of "fines," this being reflected in any particular group which is separated. Thus in view of the small proportion of this fine material, and its effect in producing what may be regarded as a somewhat spurious variability index, we would be justified in ignoring it for purposes of evaluating the flour. If this is done the variability index then becomes 4, which is a considerable improvement on the previous figure and more nearly coincides with the figure expected from a visual estimation.

As there are some points about this flour which are worthy of mention, suppose we examine briefly the morphology of this unground material, the immediate effect of which is to bring to light the fact that there are two distinct types of particles. In Fig. 155 we see three particles of sawdust, A, B and C, produced as a result of sawing the wood across the grain. It will be clear that the length of any particle so generated will be limited to the thickness of the saw, this being the dimension "a" as regards particle A. The breadth of the particle, however, does not suffer from such strict limiting conditions, as the pressure and depth of tooth in the saw will presumably influence this dimension; thus particles B and C will be seen to be of very much the same length as particle A, but their breadth varies somewhat.

It will be appreciated that as a result of this structure the particle will be mechanically weaker than one in which the tissue elements lie in the direction of the greatest dimension, such as exists in the particles D, E and F, which result from sawing the wood along the grain. But in view of the fact that material such as this is destined to be ground to flour, the cross-grained particles should be much easier to defibrate, the disadvan-

Fig. 156.—Beech wood flour, ground by modified technique (80 mesh), polarized light, system crossed. Mag. 34 diameters.

tage of this appearing to be that the ultimate particles resulting from this breakdown would all be of much the same length, but rather on the short side; and whereas the particles are required to be as long as possible, a flour produced by reducing these particles to their structural units would be finer than that generally used for filling moulding powders.

Against this, however, such a flour would be expected to possess a small variability index, and it is highly probable that in spite of its fineness it would function more efficiently as a filler than the materials in use at present, both from the point of view of strength and of finish. It would appear, therefore, that in this question of the direction in which the wood is cut in the first instance we have another factor influencing the production of the ideal flour.

The effects of defibration or grinding on the cross-cut particles are seen when some ground beechwood flour is examined. This is illustrated in Fig. 156, where we have a photomicrograph of some 80 mesh flour produced by the modified technique of grinding already mentioned. This photomicrograph is at the same magnification as the last, and allows us to obtain a direct comparison. One of the cross-cut elements in the process of being defibrated is seen at A, the manner in which it breaks down being clearly shown; that is to say, the histological elements of the particle are seen to be separating longitudinally so that they retain their original length, dictated by the length (or breadth, according to which way we decide to view the particle) of the particle.

On the other hand, particle B is cut with the grain of the wood, and the action of the grinding is seen to have been to start defibration at what is presumably the weakest point, so that instead of breaking the particle down into elements of the same length as itself, they would be considerably shorter than the original length, resulting in the production of individuals C and D of the small particle type.

It will be seen that having two types of particles, such as the "cross cut" and the "long cut," which react to the influence of the grinding machines in different ways, the chances of producing a mixed flour are greatly increased; thus in this particular specimen we have a clean flour, showing very few of the small particles such as were met with in the third group of the American softwood flours. In fact, the proportion of this type of material in the sample under consideration is so small that we may again ignore it for purposes of obtaining a figure for the variability index, which, when calculated on this basis, comes out at 19. This will be seen to be four times as great as that for the unground beechwood flour, which shows the effect of grinding to be to bring about heterogeneity to some extent, although it should be borne in mind that this might probably be due to the sieving operations not being as comprehensive as possible.

In summing up the foregoing remarks, we may say that the variability index is useful on its own, by indicating the condition of a flour so far as its consistency of particle size is concerned, but when it is used as a means of assessing the functionality of a material, it must be used in conjunction with the proportions present of any distinctive groups in the flour capable of being separated, otherwise misleading conclusions are liable to be formed as a result of the production of spurious index figures.

(To be continued)

Synthetic Resin Adhesives

The requirements and properties of adhesives for wood is the subject of recently published Forest Products Research Bulletin No. 20 (H.M. Stationery Office, 6d.). One of the conclusions reached is that the successful gluing of wood depends alike upon the nature of the adhesive and the technique employed. The bulletin has been prepared at the request of the Adhesive Makers' Panel, which was created early in 1945 to develop collaboration between industry and the Forest Products Research Laboratory. Five pages of the bulletin are devoted to synthetic resin adhesives.

Planned Mould Maintenance Service Aids Economical Production

Section XXII (contd.)

By W. M. HALLIDAY

In this instalment the author gives further examples of time-saving devices to aid the work of the mould repairer, commencing with a consideration of such features as relate to water-cooling provisions on the mould.

NOT only will a number of operating snags arise in the way of producing sound moulded articles if there exists poor or incorrect control of mould temperature, but also the risks of increasing mechanical faults to the mechanism itself. Thus sliding or rotating members may be liable to seize up more quickly if the mould is operated in a overheated condition, while effective lubrication will be rendered more difficult, thus further aggravating such seizure tendencies.

It is essential for the toolmaker to assure correct feeding of the cooling water through a mould, and to give close attention to the condition of all water cooling channels, stop plugs, outlets, etc. Such parts often rapidly become choked with lime deposits, or with uncleared chips, dirt, etc. It will be advisable to make an inspection of same each time the mould is sent to toolroom for overhaul, adjustment, or correction.

The mould designer can often very materially assist towards this end by initially designing the water-cooling system so that awkwardly shaped or situated holes, stops, drain cocks, etc., are avoided. Where possible all such holes in the block should be drilled *at right angles to each other, and at right angles to the sides of the block itself*, as such locations are more readily accessible and far easier to drill. Care should be taken to locate these holes on the exterior surfaces of the mould block to allow the part to be easily set-up and access afforded to them even when the mould is attached to the machine platens.

Considerable care will also have to be exercised by the mould engineer, and maintenance toolmaker when making modifications to a mould construction, lest the location of additional holes for some extra part leads to a leakage of the water cooling system. The attachment of further units to a mould may cause a stoppage in the flow of water through the cooling channels, because of a screw or dowel being inadvertently located in such a manner as to pass through one of the channels.

Hardening of Mould

Here is yet another feature often resulting in numerous puzzling operating snags If the hardening of parts is not effectively carried out on the original mould, undue wear may result, with increased tendency to seize of the associated members. Very careful attention must be paid to the complete heat treatment process so that uniform degrees of hardness are achieved on all parts of the mould. If not, soft patches may be present, which, of course, will be subject to more rapid wear with resultant loss of accuracy, tendency to leak or flash formation, and likelihood of seizure.

Particularly will this be the case with regard to sliding cores, or core slides, or rotating members within the mould block. Similarly, the guideways or holes for all such members should not only be of the required degree of hardness and uniformity, but all scale or blisters must be removed before final assembly of the mould.

Where intricately shaped cores, sub-blocks, etc., have to be employed it is often advisable and more economical to have these hardened to a somewhat higher degree than their housings, in

order to ensure that the most easily replaceable member shall take any wear likely to develop. This point, incidentally, if carefully watched, may save the maintenance toolmaker a great deal of worry and time, since normal replacement to counteract wear will then be confined to the simplest and most economical units rather than to the more expensive. Conversely, it may be preferable to have the component left softer than the housing in block, rather than risk harmful wear occurring upon the more complex block.

Initial Setting-up of New Mould

The author has frequently noticed that when a completely new injection mould has been finished off and passed to the production shop for testing, damage has been inflicted upon some vital portion at the outset, due to no other reason than the unfamiliarity of the setters and operators with its construction and method of functioning.

This is an important aspect of maintenance, which deserves closest co-operation from the designer downwards, and it should be made standard practice for both the designer and maintenance toolmaker to be present to see the mould set up and run for the first time. Under such critical scrutiny the risks of injury to the mould will be considerably minimized, and, in addition, the maintenance toolmaker will become acquainted with any unusual snags or features appertaining to the tool.

It is customary practice when subjecting the new mould to its first test on the machine to run off a few score of mouldings at the least, and, then, if these are passed correct, to proceed with production proper. Serious troubles may sometimes be averted if, after the test pieces have been produced, the tool were to be removed and passed over to the toolmaker for his close examination. As the writer knows it is often easy to detect signs of strain, or weakness of some unit, which may easily be remedied at that stage, so rendering possible a more prolonged and trouble-free production run later.

Condition of Fixing Screws

Coupled with this matter is the related one of the condition of fixing screws, clamps, etc. Many a sound and first-class mould has been ruined due to poor clamping or fastening devices employed, the condition of which it has apparently been nobody's business to watch.

The care of these adjuncts to the injection mould should be placed in the charge of the maintenance toolmaker, and one good plan is to ensure that every new mould is supplied with brand-new clamping screws, fixing plates, clamp strips, etc. This simple and seemingly obvious provision will serve to avoid a number of snags, chief of which are the following:—

(1) Stripped threads in the blocks. By using worn retaining screws for affixing the blocks to the platens, the threaded holes in the blocks may become ruined and incapable of ensuring a sound grip to the part.

(2) Such faulty retention may lead to a serious breakdown of mould during production, due to misalignment of one block.

(3) Insufficient screws may be at hand on the machine, this incurring the risk of the mould being insecurely held on the machine.

(4) Badly worn clamping plates may be employed, with harmful effects upon the degree of retention of the mould.

(5) Screws may be used which are too long, or clamp plates which are too large, causing interference with the movements or proper functioning of some important mould component, which as a result becomes strained or broken at the first run of mould.

Where the new mould has detachable insert holders, or magazine feeding mechanism manually operated, it is important that every possible safeguard be taken during the test period to provide that the operator is properly instructed as to the requisite movements, and the consequences likely to occur if mistakes or omissions are made.

This is largely preventative action which, if intelligently conducted, will go

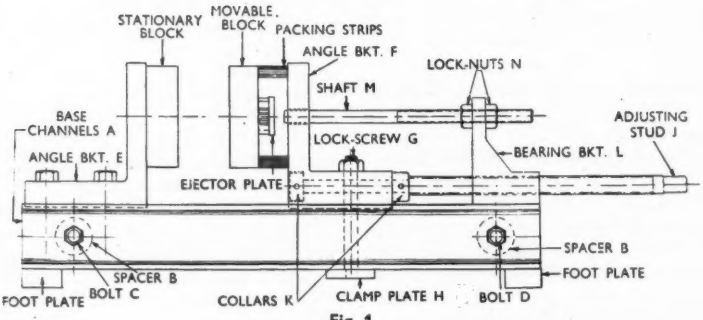

Fig. 1.

far towards eliminating at least some of the most obviously preventable troubles which confront the maintenance man from time to time.

Fixture to Facilitate Handling

One of the chief difficulties confronting the maintenance toolmaker lies in effectively holding the moulds in such a manner that the normal functions of the tool may be performed.

In the case of very heavy moulds, or those where the overall dimensions of the block are considerable, such operations will be very appreciably hindered. Very often the engineer has to resort to the use of tapered wedges driven between the main blocks, or to pry-bars in same application for forcing apart these members. This means, of course, that the parting-line surfaces of each block are liable to get seriously chipped and bruised.

But this is not the worst possibility likely to arise from such undesirable practices. Since it will not be possible to apply a sufficient number of wedges or pry-bars for equally forcing apart the blocks, there will be a strong tendency to open out one side more than the other, thereby causing undue strain upon the registering dowels. Strained dowels would result in misaligned blocks, flash on finished moulding and additional work required for their eventual correction.

Such methods are to be deplored, especially since it is comparatively easy to fashion and install a most simple, yet effective, holding and parting device for the mould blocks.

Fig. 1 shows such a fixture, which has proved most convenient and is capable of dealing with a variety of mould sizes both safely and quickly, whether for straightforward block holding whilst undergoing repairs or for making the necessary parting movements required when testing the mechanism of a mould. The latter functions can be performed under what are practically identical conditions as pertain when the mould is installed on the machine, except that no plastic charge is present, of course.

Referring to the diagram shown at Fig. 1, the holding fixture comprises three main members. A is a built-up base frame, consisting of two pieces of channel iron of any convenient length, which dimension will, to a large extent, be determined by the size of moulds to be catered for, and by the amount of mould-block opening involved. The channel pieces are securely affixed together so as to make a rigid unit having a space between the two parts, as shown at B, and connected together by spacing washers and bolts C and D respectively, by which means the requisite parallel gap is created.

After fixing together in this manner, both top and bottom faces should be carefully machined to make perfectly flat and parallel with each other. Likewise, the sides of the gap up middle should be machined again, to ensure exactly

parallel space, as this is employed for correctly registering other members of the fixture.

On the top face of this base and at one extreme end is permanently fixed a right-angled plate E. When machining and fixing this member, great care will be required to bring the vertical face of the angle plate perfectly square with the flat top of base. The bottom face of the plate E may be tongued, so as to fit snugly into the parallel gap, or, if desired, two or more dowels could be drilled through both members to assure permanency of alignment.

A similarly shaped and dimensioned angle block F is provided, the under side of which is tongued to be a close sliding fit within the gap in the bed. Again, the vertical face of this plate should be dead square with base-top surface and, moreover, when both plates are correctly mounted their vertical faces should be parallel in every direction. This latter provision is important, as the alignment of moulds to a large extent will depend thereon.

Means is provided for locking angle block F securely to the baseplate, as shown by the locking screw G, which passes through a standard-diametered hole in bottom side of block and through the gap between channels comprising the base. A stiff clamp plate H on underside of base serves to retain the screw in position and for clamping angle plate to bed.

The vertical faces of each angle block are drilled with a number of fixing holes, these being located on precisely the same centres as the proper fixing holes in the machine platens. The external dimensions of these vertical faces, incidentally, should be made the same as those of the machine.

If desired, instead of circular holes in the angle plates, elongated slots may be employed, these adding to the range of mould sizes within the capacity of the holding fixture.

Some facilities should also be provided whereby the angle plate F may be readily adjusted along the base and clamped up to the fixed angle plate with the requisite pressure to be commensurate with that existing on the injection machine platens. This is secured by employing a long-threaded stud J, secured to the rear face of angle plate F in such a manner as will permit it to rotate freely but restricted in endwise movement independent of the angle plate. This is accomplished by reducing the end of the stud diameter until the threads are removed, passing this portion through a plain hole drilled through the plate, and then fixing a stiff, mild-steel collar K to shaft at each side of the plate, so that only working clearance is allowed, as indicated in the diagram. It will also be noted that the collar at front of angle plate is sunk within a suitable recess machined in front face of plate, so that no overhang exists. This simple precaution will obviate numerous objections in possible interference with mounting of larger mould blocks.

The threaded part of the stud J is screwed through a tapped hole machined in the stiff bearing plate L, which, in turn, is secured permanently to the end of the base channels. For easy manipulation of the adjusting stud J, the extreme right-hand end is squared to take an ordinary swape or lever. The adjusting stud should be made long enough to impart movement to plate F over the full length of base channels.

Suitable packing pieces should be provided, so that when a mould block is installed on the fixture the movable block carrying ejector gear, etc., may be set sufficiently in advance of the front face of plate F to afford due clearance for the ejector rail, as is shown. Care should be taken to make all such packing pieces exactly the same thickness and perfectly flat, with sides machined square to each other.

Actuating the Ejectors

As will be seen, bearing plate L is extended upwards for a sufficient distance to receive the shaft M, which member is

made long enough to pass through a close-sized hole drilled through the vertical face of plate F at a point approximately on the centre of the plate. The opposite end of this shaft is threaded and two check nuts N are employed, one each side of bearing plate L as shown. This shaft is used for actuating ejectors on a mould being tested, functioning in the following simple manner:—

When a pair of mould blocks has been bolted to the fixture, the adjusting stud J is operated to bring the blocks into the closed position. Shaft M should then be adjusted horizontally until its left-hand endface is brought into the appropriate position so as to arrest the travel of the ejector rail when the angle plate F and its mould block is withdrawn from the closed position. Thus, as the mould is opened on the fixture, the ejector mechanism can be actuated at whatever point desired.

With this device it will be possible for the maintenance toolmaker, after repairing a mould, to check over the following vital items, which otherwise would have to be deferred until it was convenient to install the mould on machine.

It enables the correctness and closeness of parting-line seal to be checked very simply. The alignability of dowels or projecting core members engaging both blocks may also be determined readily. Again, in respect of the functioning of the ejector mechanism, this may be fully tested to ensure correctness of adjustment, freedom of sliding movement and absence of fouling other working members of the mould. The proper sliding or rotary movements of essential cores may be speedily checked to secure positive positioning and locking into moulding situation. These are some of the chief points which the fixture renders possible of solution, but there are a number of minor items, which, if capable of being ascertained before the mould is fastened to the machine, will prove of convenience.

These points include the determination of the best locations for push pins impinging on the ejector rail, so that the push is exerted central to area of resistance caused by the ejector pins. In like manner, where a mould has several small sliding cores operated by being attached to a single plate or slide, in its turn actuated by stationary push pins, it is often very difficult to decide just where to situate the operating pins on the plate to obtain equal thrust upon each core. By means of the fixture just illustrated and described, it is a comparatively simple matter to fasten the mould thereon and find such locations by trial-and-error methods. Where inserts have to be employed in connection with a mould, it is often highly desirable for the engineer to be able to test the working of the mould before finally determining the means for feeding the inserts into their correct place. With the fixture at hand, the mould could be placed thereon and trials made in the type and situation of insert-feeding mechanisms.

Time-saving Appliances

In the remaining portion of this section attention will be given to various useful time-saving toolroom appliances and fixtures, whereby the repair and testing of compression-type plastic moulds can be greatly facilitated along the same lines as the foregoing suggestions made in respect of injection-type moulds.

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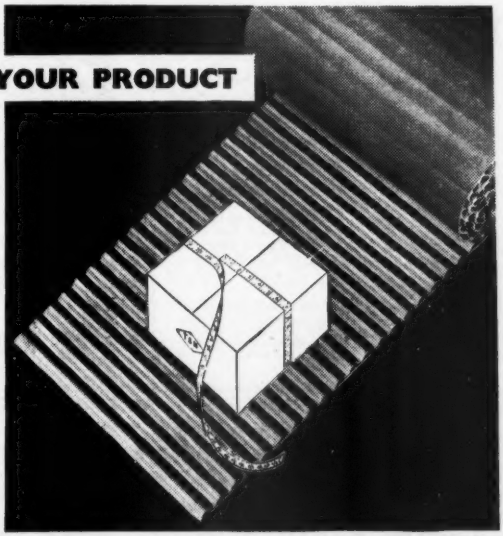

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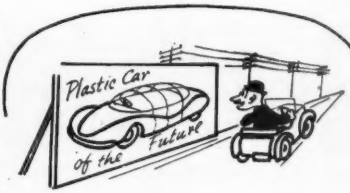

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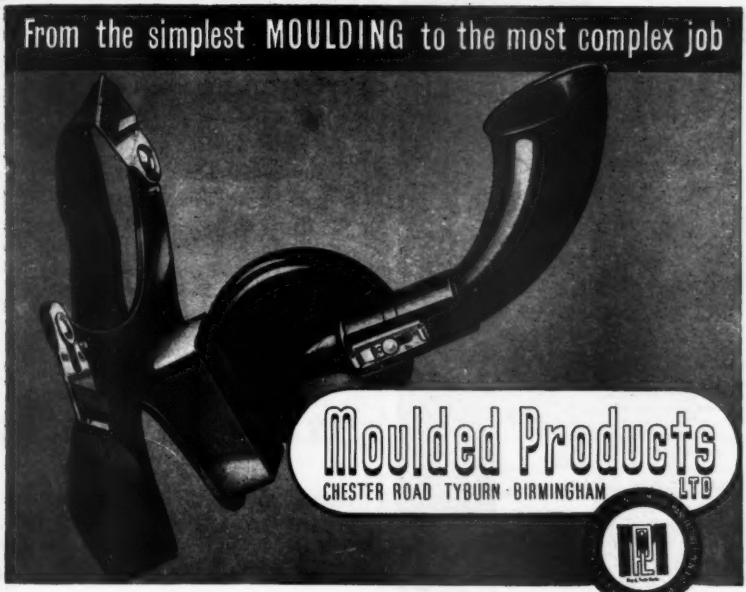

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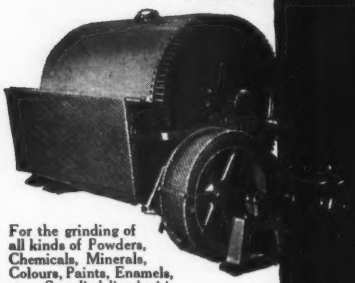

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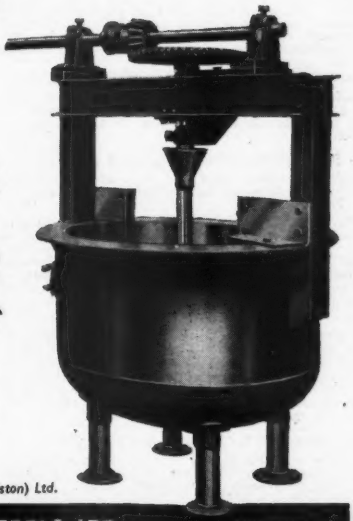

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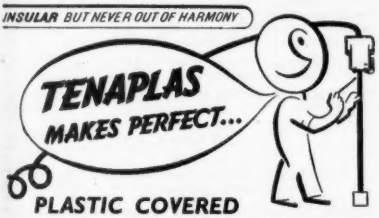

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High Frequency sealing machine for sale, 200 watt output, suitable for welding P.V.C. and other thermoplastics: can be used for H.F. moulding, £100. Accessories available if required. For further details write: Industrial Research Corporation, 4 Pembroke Walk, Kensington, W.8. 117-x5841

IMMEDIATE DELIVERY EX STOCK AT LOW PRICES.

One 4-ft. 6-in. double-roll edge runner mills.

30 Cast-iron Government surplus erecting benches, 9 ft. by 2 ft., fitted six C.I. legs, £15 each only.

Stainless filter vessel, 1-ft. 6-in. diameter, 1-ft. 6-in. deep.

Kestner 200-lb. w.p. air heater, 20 ft. by 3 ft. 2 ins.

Two air receivers, welded, 19 ft. by 4 ft. 2 ins., 150 lb.

Three G.W.B. electric furnaces, circ. Government units, 5 ft. 8 ins. o.d., 8 ft. 4 ins. o. len., with recorders, etc.

14 Welded retorts, 1 ft. 9 ins. by 1 ft. 6 ins. by 8 ft. 3 ins.

25 tons const. channels, 12 ft. by 3 ft., £14 ton.

Steel-Shaw A.C. motor-driven paint agitator.

Three 1½-in. rotary lacquer or varnish pumps.

Two A.C. driven three-throw vertical ram varnish pumps.

Four new Canning treble-cased ovens, 6 ft. by 6 ft. by 6 ft.

Three new asbestos electric ovens, 6 ft. by 3½ ft. by 5 ft.

Trolley jacketed dryer, 30-ft. long, 8-ft. 6-in. diameter.

Ver:. two bowl rubber calender, solid rolls, 24 ins. by 13 ins.

Spiked roll pre-breaker (previously used asbestos).

Complete chromating plant by Canning.

Complete Parkerising plant.

Foxry continuous Trichlorethylene degreaser.

Selection only from stock. Send your inquiries.

HODSON AND CO. (MACHINERY), LTD.,
TOTTINGTON, BURY, LANCS.
Phone, Tottington 123-4.

117-37

For sale.
One straining press for plastic materials, 340-ton down-stroke type with piston ram, 14-in. diameter by 4-ft. 6-in. stroke; fitted with steam-heated extrusion pot, 12 ins. diameter by 3 ft. deep; pot being actuated by means of two piston-type rams and having a holding pressure of 35 tons. Complete with full set of pumping equipment and valve gear.
George Cohen Sons and Co., Ltd., Wood Lane, London, W.12. 117-11

Machinery, Tools and Plant (contd.)

SPECIAL OFFER—HYDRAULIC PLANT.

10-cwt. hydraulic accumulator by Tangye, tank type, 6 ft. diameter, 6 ft. deep, with three-throw pumps.

Two hydraulic intensifiers by Vickers-Armstrongs (Government surplus), 45 tons w.p.

Two Vickers motor-driven horizontal hydraulic pumps, direct-coupled units, with reduction gear, 5 tons w.p. Immediate delivery ex-stock. Really low prices.

HODSON AND CO. (MACHINERY), LTD.,
TOTTINGTON, NEAR BURY.
Phone, Tottington 123-4.

117-38

For sale.
Two hand-injection moulding machines by Dowding and Doll, capacity 10 g.p.m. (.35 of an ounce), capable of 30 to 300 shots per hour; mould opening 5 ins.; material cylinder fitted with band-type heating element, with thermostatic control; automatic feed device.
One Francis Shaw hand-injection moulding machine, capacity ⅜ of an ounce, complete with heating elements and thermostatic control.
George Cohen Sons and Co., Ltd., Stanningley, near Leeds. 117-10

Injection moulding machine, hydraulic, by Henry Berry, 4 by 2¼ by 10 ins. stroke, die space 8 ins. square, 11 ins. deep, working pressure one ton square inch. Details and inspection by appointment. Box 6657, care of "Plastics." 117-22

For sale. Perspex blowing table unit, complete with speed-togs clamps, compressor and holding-rings, £45; ex-factory. O-ess Products, Ltd., 2 Emlyn Street, Newport, Mon. 117-36

Machinery, Tools and Plant Wanted

Wanted to purchase, existing small plant for compression moulding in working order. Full particulars to Box 6669, care of "Plastics." 117-14

PATENTS

The Proprietors of British Patent No. 523,477 are prepared to sell the patent or to licence British manufacturers to work thereunder. It relates to apparatus for moulding plastic materials. Address: Boult Wade and Tennant, 112 Hatton Garden, London, E.C.1. 117-3

Patentee of small kitchen fitting, suitable for phenolic moulding, desires contact with view to exploitation. Box 6367, care of "Plastics." 117-x7611

PRODUCTION CAPACITY AVAILABLE AND WANTED

Pulverizing and grading of raw materials. Donm, Ltd., 167 Victoria Street, London, S.W.1. zzz-369

WELL-KNOWN FIRM
with
EXTENSIVE HOME AND EXPORT SALES ORGANIZATION.
invites offers of
ENTIRE OUTPUT ON PROMPT CASH BASIS
BY MANUFACTURERS OF
MECHANICAL METAL AND PLASTIC TOYS AND NOVELTIES.
Apply, Box 2405, care of "Plastics." zzz-383

Required, regular supplies about 1 ton per month of solid organic waste with low ash and sulphur contents. Written replies, if possible with samples, to Box 5882, care of "Plastics." 117-8704

Repetition in Ebonite, Erinoid, etc. Capstan lathe work. Mansell, Temple Street, Rugby. 125-8451

London firm requires for home and export market plastics, household goods, including beakers, cups, saucers, plates, spoons, etc., in urea or phenol formaldehyde. Box 1427, care of "Plastics." 118-8062

STOCKISTS OF I.C.I. "PERSPEX."
ALMEX, LTD.,
IMPERIAL WORKS,
Inquiries to:—
EXCHANGE BUILDINGS, STEPHENSON PLACE, BIRMINGHAM, 2.
Phone, Midland 0682.

For immediate delivery. Standard and non-standard sized sheets of I.C.I. "Perspex."
A service intended for consumers of small quantities or special requirements in size. 117-5

Production Capacity Available and Wanted (contd.)

Work wanted, tool room available for all sorts of press tools. Press work, assembling, spraying and all sorts of engineering to your design. Universal Components, Ltd., 19 Sunderland Terrace, W.2. Bay. 6776. 119-7900

S. R. F. FREED, LTD.,
THE STOCKISTS OF SHEETS, RODS, TUBES, OFFCUTS AND SCRAP,
OFFER OTHER LINES WHICH CAN BE USED IN COMBINATION WITH PLASTICS, UTILIZING ANIMAL AND VEGETABLE PRODUCTS,
Such as tortoiseshell, horn, cleaned and prepared cattle bones for industrial purposes, vegetable ivory nuts, porcupine quills, goose and duck feather, and barrels, etc.
S. R. F. FREED, LTD.,
27b HIGH STREET, SOUTH NORWOOD, S.E.25.
Phones, Livingstone 4042; Sanderstead 2056. 121-402

GRINDING AND KIBBLING.
TRADE INQUIRIES INVITED.
WE BUY AND SELL ALL PLASTIC MATERIALS.
BOX 5490, CARE OF " PLASTICS." 117-41

We are able to undertake certain small runs of plastic moulded products and individual plastic moulded products. Use our services for the preparation of prototypes in plastics. All inquiries strictly confidential. Cottrell and Co. (Plastic Section), 15-17 Charlotte Street, London, W.1. zzz-394
Wanted, large quantities of plastics toothbrush handles. Samples and quotations invited. Please contact Cawnpore Industries, Ltd., Cawnpore, India, by airmail. 118-x6657
Sales organization are desirous of contacting actual manufacturers who wish to find a market, both home and export, for their products. New good lines, whole production taken. Box 5988, care of " Plastics." 118-x6542
Quantity of plastic moulds, compression and injection, in new condition, for sale. Box 6155, care of " Plastics." 118-x7095
Cartons.
We are large stockists of new and once used cartons. Once-used cartons in corrugated and fibre-board are carefully sorted and are in every respect equal to new. We would welcome your inquiries. List upon application.
Export cases.
We are able to make any quantity of export case. Delivery within 14 days of receipt of order. A sample case is dispatched before purchase, for test and inspection. For the home market we can make cases to your specification from seasoned converted timber without licence.
Wooden boxes measuring 21c by 12½ by 8 always in stock at 2s. 3d. each delivered London or F.O.R. Full tea chests 4s. 6d. each; half chests 3s. 6d. All clean and sound, coopered or uncoopered.
We can supply gummed tape up to three inches width, and can incorporate the trade mark of your company for a charge of 1s. per coil extra.
Large stocks of paper always in stock, and your inquiries are welcomed.
Our packing service can accept your goods, pack them, see to documents and place on board ship.
If your problem is packing, consult the specialists
W. Page and Sons, 34 Langside Crescent, Southgate, London, N.14. Phone, Palmers Green 5087.
Redundant cartons, in first-class condition, purchased for cash. zzz-398
Manufacturers of novelty moulded plastic fancy goods invite inquiries from wholesale distributors and exporters. Early deliveries. Principals only. Box 6223, care of " Plastics." 117-9078
Ebonite and bakelite always in stock. Phone, Archway 3654. A. E. Goodeve, Ltd., 188a Seven Sisters Road, London N.7. 121-9075
Mould-making, injection and compression, and moulding capacity immediately available. Box 6195, care of " Plastics." 118-9074
Thermoplastic scrap. We are large buyers of P.V.C. polythene and acetate scrap and offcuts. East Anglia Chemical Co., Ltd., Aycliffe, Darlington. 117-9073
Wanted, a factory to undertake the making of first-class plastic bags. Long periods of work guaranteed. Send details to Box 6698, care of " Plastics." 117-29
Perspex. We are stockists of I.C.I. Perspex. Try us for your requirements of coloured sheets. Cuprex, Ltd., 1-3 Robert Street, Strand, W.C.2. Temple Bar 0902. 117-26
South Coast Wholesalers wish to contact actual manufacturers of plastics goods and novelties for next season. Send illustrations and price list to Box 555, Smith's, Square, Bournemouth. 117-25

Production Capacity Available and Wanted (contd.)

Moulding Powder, Bakelite X250 heat resisting, 6 cwt. for sale. Box 6670, care of " Plastics." 117-24
Injection Moulding Capacity available ⅛-oz. shot) for cellulose acetate powder, using customer's moulds and powder. Write Box 6661, care of " Plastics." 117-20
Tufnol, Pascolin Board, Bakelite, Ebonite, Erinoid, Presspahn, electrical tape, etc., for sale. Box 6663, care of " Plastics." 117-19
Wanted urgently for export, offcuts or full-size sheets of celluloid, Bexoid or similar, approximately .010 in. thick, any colour, transparent. Offers to 6664, care of " Plastics." 117-18
High-frequency Welding of P.V.C. articles. Operators with capacity required. Write, Box 6666, care of " Plastics." 117-17
P.V.C. Piping required in large quantities. Submit samples and quotations to Box 6665, care of " Plastics." 117-16
1½-2-oz. Injection Moulding Capacity required; own mould supplied. Box 6667, care of " Plastics." 119-9355

Advertisers having appointed permanent resident agents with showrooms in the following countries:—Canada, India, British East Africa, Union of South Africa, New Zealand, British West Indies, Bahamas, Malta G.C., Holland, Belgium, Norway, Denmark, Turkey, Tunisia, Portugal, Portuguese East Africa, Finland, Uruguay, Peru, Chile, China and Mexico, are arranging to print a new catalogue of their own and Associate Companies' manufactures, and propose setting aside a section to Plastics. Would actual manufacturers who have Plastic articles they consider likely to be of interest and competitive (both for present and long-term deliveries) in the above-mentioned countries kindly submit as far as possible illustrations and full particulars as to weights, dimensions, output, prices, etc., to Box 6668, care of " Plastics." 117-15
Capacity available for mould-making and die-sinking; expert workmanship, with good delivery dates. Apex Tool Co., 56 Bermondsey Street, S.E.1 (near London Bridge Station). 117-8
Moulding powders. Cellulose acetate virgin material, soft medium flow; specific colours, light blue, navy blue, royal blue, red, pink, turf tan, green, chocolate brown. Polystrene virgin material, six colours. C.I.F. and f.o.b. quotations given against specific inquiries. Dominion Export Co., Ltd., 11-15 Oxford Circus Avenue, London, W.1. Phone, Gerrard 2931. Cables, " Stepla, London." 117-2
For sale, finely ground material, suitable for the plastics industry; large quantities available. The Oilcakes and Oilseeds Trading Co., Ltd., 108a Cannon Street, London, E.C.4. 119-9357
High-frequency sealing capacity available for P.V.C. etc. Sealing, welding of all kinds. Send inquiries to Industrial Research Corporation, 4 Pembroke Walk, London, W.8. 119-x8534
Urea powder wanted in large or small quantities: offers, Box 6671, care of " Plastics." 119-9354
Perspex sheet. Ashdowns, Ltd., Eccleston Works, Knowsley Road, St. Helens, are stockists and will be pleased to quote against specifications. 117-x8369
Perspex Off-cuts, clear and coloured, cut to required size, lactoid rods and all forms of scrap plastic material; immediate delivery. Write, Plastic Department, J. E. Hoare, Byton Chambers, Amen Corner, S.W.17. zzz-399
Wanted, plastic waste and plastic piece goods. Send particulars, stating quantity and price. Box 6695, care of " Plastics." zzz-400
Injection Moulding Capacity available (4 oz. maximum) for long runs. Grinding and kibbling also undertaken. Box 6659, care of " Plastics." 117-39
Polystyrene Moulding Powder urgently required, transparent or opaque, against cash payment. Write, Box 6697, care of " Plastics." 117-401
Design. We would gladly collaborate with your own staff on product and tool design. Hart-Still and Associates, Industrial Designers, 880 Green Lane, London, N.21. Laburnum 6121. 117-35
Toolroom capacity for manufacturing moulds. Seaward Engineering, Ltd., 24 Hammersmith Bridge Road, W.6. Phone, Riverside 2246. 117-44

SITUATIONS VACANT

Representative, with extensive connection among users of plain, printed, embossed and fabric-coated P.V.C. sheeting required; trial four weeks part-time on commission. Permanent situation if satisfactory. Apply, Box 4974, care of " Plastics." zzz-392
Shorthand Typists, Private Secretaries, Clerks, etc. If you are in urgent need of staff, contact Embassy Secretarial Employment Bureau, Excel House, Whitcomb Street, W.C.2. Whitehall 5924. We specialize in efficient personnel. 124-8069
Designer having technical knowledge of mould layout required immediately for Plastics firm in Middlesex. Applicant must be able to plan and prepare working drawings and will be encouraged to submit own designs. Box 6655, care of " Plastics." 117-33

Situations Vacant (contd.)

Works Manager, fully experienced in moulding and general plastics. Engineering and Administrative knowledge essential. Commencing salary £500 per annum and bonus. Good prospects for right man with ability. State age and experience. Bath area; accommodation arranged. Box 6654, care of " Plastics." 117-32

Plastic Technician or Scientist, capable of directing research and development, required for the utilization of thermoplastic scrap. Only applicants with practical experience and high qualifications, in particular with practical knowledge of American methods, need apply. Company wishing to engage applicants intends to reorganize and extend its plastic department, and successful applicants would have substantial income, good prospects and permanent position. Box 6658, care of " Plastics." 117-23

Production Foreman required for rubber works in South-West London district, must be experienced in handling rubber mouldings. Only persons of experience and proved ability and able to control labour need apply to Box 6662, care of " Plastics." 117-21

Old established leathercloth firm require qualified chemist with experience of plastics production, especially P.V.C., able to conduct research and supervise production, good salary on rising scale—five-day week, permanent post for right man. Living accommodation will be found. Apply, in writing, to Dermide, Ltd., Valley Mills, Meanwood Road, Leeds, 7. 117-13

Tool Room Manager required with up-to-date experience of design and maintenance of dies for hydraulic injection plastic moulding machines, and small press tools, in modern tool room.
First-class opportunity for young man in a company with rapidly expanding business, salary to commence £550 p.a. Reply in first instance in writing, giving full particulars of experience, etc., to International Model Aircraft, Ltd., Plastics Division of Lines Bros., Ltd., Morden Road, Merton, S.W.19. 117-12

Mechanical Draughtsman required, age 22-25, tool experience an advantage, but not essential. Write, stating age, experience and salary required, to Lacrinoid Products, Ltd., Stafford Ave., Gidea Park, Essex. 117-6

Albright and Wilson, Ltd., invite applications for their Technical Sales Staff in the South Eastern area and Yorkshire in connection with development of the uses of Dow Corning Silicone products. Applicants should preferably hold a science degree or its equivalent and be between the ages of 23 and 33. Details of experience and qualifications should be sent to 49 Park Lane, London, W.1. 118-9356

SITUATIONS WANTED

Technical and commercial manager, plastics division, desires change, specializing in utilizaton of thermoplastics scrap, development of moulding powders, best connections in industry, up-to-date knowledge of latest American methods, prepared to extend existing or start new company. Box 6218, care of " Plastics." 117-9076

Tool-maker, conversant mould making for plastics, desires change, firm of stability and repute. Box 6692, care of " Plastics." 117-x8640

Injection moulding, 11 years knowledge, moulding, finishing, inspection; tools, material, etc. Desire change, London area. Box 6443, care of " Plastics." 117-x7913

Works foreman desires change, preferably in Essex, experienced in plastics moulding, machining, manipulating and designing, also labour control. Box 6653, care of " Plastics." 117-x8318

Plastics engineer (32) desires executive position in London or Southern England, 15 years' experience in the moulding industry, expert on mould design and production of mouldings by compression, injection and transfer techniques; sound experience of estimating, product design, plant installation, finishing, etc.; excellent references. Box 6638, care of " Plastics." 117-x8538

TIME RECORDERS

Factory time recorders, Service rental. Phone, Vigilant 4731. Time Recorder Supply and Maintenance Co., 157-159 Borough High Street, S.E.1. 125-8459

WANTED

Acetate and nitrate. Sheet off-cuts and scrap plastic materials of every description wanted. We can arrange collection. Top prices paid. Lloyds, 72 Bridge Street, Christchurch, Hants. Phone, Christchurch 504. zzz-51

Scrap. Why not let a well-established firm quote you for cellulose acetate, Perspex, P.V.C. cuttings and other thermo-plastic off-cuts and scrap? Having best use for these materials, highest prices can be paid. Quotations on receipt of representative samples to M. H. Grist (Plastics), Ltd., 82-84 Brighton Road, Surbiton, Surrey. Phone, Elmbridge 4214. zzz-395

Wanted (contd.)

Moulding Powder wanted for export, general-purpose phenolic. State specification, colour, etc. Box 5656, care of " Plastics." 117-x5602

Wanted, moulds for injection moulding machines 3 oz. and Reed-Prentice 8 oz. Contact Cawnpore Industries, Ltd., Cawnpore, India, by air mail. 118-x6657

Wanted, information regarding manufacturers of plastic Bee-feeders. Advertiser anxious to purchase several of same. Write, Glen, Reporter, Alexandria, Scotland. 117-4

Acetate (cellulose) sheeting.
Wanted to purchase for cash, any quantity, colour or thickness. Send particulars with samples.
Allans, 37 Farringdon Street, London, E.C.4. 119-9352

Sufficient ½-in. thick Sindanyo required urgently to cut 1,200 pieces 2⅛ ins. by 11 ins. Reply Box 6693, care of " Plastics." 117-x8640

Acetate sheet and offcuts urgently required in white and pastel shades, up to 8s. 6d. per lb. paid for clean material. Also injection moulding powders urgently wanted, injection moulding scrap and sprew. Powder price paid. Studio Mfg. Co., 169-171 Brearley Street, Birmingham, 19. 119-8314

MISCELLANEOUS

Extend Your Trade.
Use a Trade Mark. Consult
Trade Mark Protection Society,
12 Church Street, Liverpool. 118-6372

For sale constantly, cut-offs of ⅛ and 1/16 in. natural Holoplast, from 1s. per lb., according to size of pieces. Larks Spraying Process, Monument Hill, Weybridge. 119-x7997

Acid containers. High-quality ebonite containers available from stock, 29 gallons capacity, suitable for handling and storing liquid chemicals, price £3 10s. each. United Ebonite and Lorival, Ltd., Little Lever, near Bolton, Lancs. 117-8706

Plastic boards, 1/16-in., specially treated, highest artistic finish, suitable for furniture, bath, splash-backs, etc., plain colours or marble effect; also wood mahogany, oak, walnut; in sheets 8 by 4 or cut to requirements. Prompt delivery. Larks Spraying Process, Monument Hill, Weybridge. 117-x5967

Photography by Behr will show your product at its best. Ask for illustrated list. 44 Temple Fortune Lane, London, N.W.11. Speedwell 4298. 121-9072

For sale, quantity of PVC coloured sheeting (some printed), also some metallic colours. Box 6444, care of " Plastics." 117-x7928

Perspex sheets, cream, medium, opal green, pink, blue, sizes 4 ft. by 3 ft., 3ft. 6 ins. by 3 ft., thicknesses 1/16 and ⅛, reasonable prices, quantities substantial. Apply Mr. R. F. Cottingham, Enterprise Works, Scunthorpe, Lincs. 117-x7984

Cellulose-acetate offcuts for sale, 20 thous. thick, polished both sides, all colours, sizes approximately 24 ins. by 5 ins. The Wearmouth Plastics Research Laboratories, 46 Laugherne Road, St. John's, Worcester. 118-x8248

Plastic boards, 1/16 in., specially treated, highest artistic finish, suitable for panelling, furniture, bath, splash-backs, etc.; plain colours or marble effect, and wood (oak, mahogany, walnut, etc.), sheets 8 by 4 or cut to requirements. Prompt deliveries. Larks Spraying Process, Monument Hill, Weybridge. 119-x7998

Six sheets of Tufnol, 50 by 25 by ⅝, for sale; offers wanted. Speedway Cars, 310 Uxbridge Road, Acton, W.3. Acorn 1051. 117-1

Monomarks. Permanent London address. Letters redirected, 5s. p.a. Write, Monomarks BM/MONO76, W.C.1. 122-9353

For sale, ex stock, 1,000 sheets vulcanized fibre, 41 ins. by 36 ins. by .10 ins. thick, 9s. sheet. Send for sample. 20,000 pairs industrial mittens, ex-Government stock, quick release wrist fasteners, suitable heavy work, gardening, etc., 4s. 6d. dozen pairs. Carriage paid on six dozen and over.
Plastic sheets, 8 ft. by 4 ft. by ⅛ in. or 1/16 in. thick, natural brown, from 1s. 4½d. sq. ft.
5,000 ft. green and tan plastic belting, 1¼ ins. wide, ribbed both sides, 4d. sq. ft.
D. H. Ridout and Son, Ltd., 12 Stedman Road, Southbourne, Bournemouth.

Lipstick case. A new kind of lipstick case for which British patent has been granted, offered for manufacture and distribution under licence or for outright purchase. Export right can be arranged. Also other patents. Articles with large volume sales. Write, Box 6696, care of " Plastics." 117-31

Redifon radio heating unit, Model R.H.21, for sale, in practically new condition. Any reasonable offer will be accepted. Write, Box 6656, care of " Plastics." 117-34

Fibestos (cellulose acetate), matt finish, 37 ins. wide, 25 thou., one roll, 4 cwt., for sale; also Perspex offcuts. Write, Box 6342, care of " Plastics." 117-x7562

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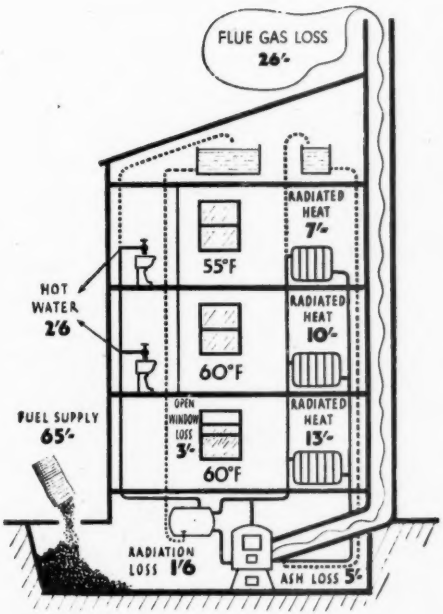

WHERE THE HEAT GOES

The heating systems of many office buildings are notoriously wasteful of fuel.

For instance, in the diagram above, you have the basement boiler feeding separate radiators on each of the three floors and there is a calorifier supplying hot water to lavatories on the two upper floors.

It will be seen that out of every 65/- spent on fuel no less than 26/- goes up the chimney in wasted heat.

This major loss can largely be reduced by a more careful firing of the boiler and making better use of the dampers.

Overheating is a frequent source of excessive fuel consumption: and windows left open unnecessarily (as on the ground floor) also contribute to heat waste.

HOW TO GET THE BEST VALUE FROM AVAILABLE FUEL

1. Install a TRAINED vigilant boiler attendant.
2. Sift all ashes and recover every ounce of unburnt fuel.
3. Keep the dampers in good order and operate them efficiently.
4. Thoroughly clean out the boiler flues at least once a week.
5. Keep a watchful eye on the radiators to eliminate overheating.
6. Avoid excessive ventilation from open doors and windows.

APPOINT A RESPONSIBLE MEMBER OF YOUR STAFF AS FUEL WATCHER WITH FULL AUTHORITY TO ACT.

ISSUED BY THE MINISTRY OF FUEL AND POWER

FEBRUARY, 1947. Vol. XI. No. 117 **Plastics** TWO SHILLINGS

Lower Slaughter
GLOUCESTERSHIRE

In this peaceful Cotswold village, life flows as quietly as the little stream that meanders between the picturesque houses.

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